THE

ELECTRICAL REVIEW.

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CONTENTS:

	PAGE
Electric Lighting Contracts and Professional Advice	25
Pupin's System of Cable Working	26
The Lyons-Oullins Electric Tramway (*illustrated*)	28
Power Losses in the Transmission Machinery of Central Stations (*illustrated*) (*concluded*)	29
Legal:—Woodhouse & Rawson United, Limited (*continued*) ...	33
Brasyer *v.* Harness, McCully, and the Medical Battery Company (*continued*)	35
The Ottawa Conference	40
Correspondence:—Alternate Current Distribution	40
New Method of Ship Wiring	41
Electricity and Gravitation	42
Variation of Electric Pressure	42
"The Living Wage"	42
The National Boiler Insurance Company	43
A Point in the Electrolysis of Alkaline Chlorides...	43
Notes	44
Business Notices, &c.	48
Contracts Open and Closed	50
City Notes, &c.	50
Traffic Receipts	50
Share List of Electrical Companies	51
Naval Dynamo Machinery	52
Present and Prospective Steam Engine Economy	53
High Speed Engine and Dynamo Combined (*illustrated*) ...	54
New Patents	55
Abstracts of Published Specifications	55

THE

UNIVERSAL ELECTRICAL DIRECTORY

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ELECTRIC LIGHTING CONTRACTS AND PROFESSIONAL ADVICE.

HAVING in the past had occasion to write on the subject of the inadvisability and incompatibility of contracting engineers posing and acting as professional consultants, we feel constrained to take the matter up again, as a most prominent case has lately come under our notice in connection with an electric light and power plant in Westminster.

This time, however, we propose to take up the subject from the point of view of the purchasers.

Naturally the chief points to aim at is to get the most perfect plant and that most suitable to the conditions under which it will have to work. To arrive at this, the whole scheme should, without doubt, be placed in the hands of a competent *professional* mechanical and electrical engineer; we accentuate the "professional status," as it is only by employing such a person with unbiassed, independent, and wide, views, and in no way connected with any manufacturer or contractor, that full advantage can be taken of the wide field of electrical science and its continuous development, with consequent advantage to the purchaser.

On the other hand, if, as we regret to say sometimes is the case, a contractor or manufacturer is called in, his judgment by the very nature of his business must necessarily be somewhat biassed, and with only the human tendency of recommending the plant that will best further his firm's present or future interest.

We do not state this at all in the way of casting any imputations whatever on such gentlemen, as without doubt whatever they advise will be what they believe in; but it is these very restricted views that we say should not be called in by the purchasers, as it practically limits their choice in the selection of the plant.

Again, the principle of contractors acting as professional advisers is altogether wrong, and it should not be encouraged any more than calling in a chemist in preference to a medical man.

Further, it will at once be seen what great incongruity exists—when a contractor acts in the professional capacity—and when it is pointed out that all information and prices he may obtain from the competing contracting firms, for the work he is being consulted upon, will be used against them at a later date when he, in his true position as contractor, may be in competition with them. As a matter of fact, we know of responsible firms who would not tender for work when a firm who at times may be in competition with them is acting as the referee, and to this extent again the purchasers suffer, or it may be that they might also be mulcted, by reason of higher prices put in by the tenderers, for the sole purpose of rightly not disclosing their bottom prices to the referee's firm.

A great injustice is frequently done to professional men

by calling them in to give their time and advice, leading them to think, by correspondence or otherwise, that they had been appointed as consulting engineers, and after they had very carefully gone into all details and submitted their report, based as it should be on an installation of high efficiency, and probably coupled with it many suggestions as to the various applications of the power for furthering economical working for special purposes, only to find that, unknown to them, contractors have been also called in and appointed to the consulting engineership.

The public are amply protected against their employing other than fully qualified members of the legal or medical professions, while patent agents, accountants, architects, &c., all have their own safeguards, and it is of serious importance and matter for regret that engineers and electricians have not some more tangible means of showing their status than simply the initials indicating they belong to one of the scientific institutions, and although the latter are more exacting now than they used to be in candidates' qualifications, yet under the present conditions outsiders cannot distinguish professional men from contractors.

The formation of a strictly professional institution or society, to which only purely professional gentlemen could belong, would once and for all settle this vexed question, and enable the interested and purchasing public to know when they were committing their interests into not only competent but independent hands.

When we have the example of such a qualified electrician as Mr. Crompton resigning his practice in consulting work because of his contracting business, and at a pecuniary loss of many hundreds a year, it is to be regretted that other principals of contracting firms do not follow suit, and act up to the same high principle.

PUPIN'S SYSTEM OF CABLE WORKING.

Our esteemed American contemporary, the *Electrical World*, is somewhat put out at some remarks which we recently made with reference to Dr. Pupin's system of increasing the speed of working of submarine cables. If we have exceeded the bounds of courteous criticism in the remarks in question, we unreservedly withdraw them, though, at the same time, we must adhere to the main facts of our contention. When an invention is based wholly, or almost wholly, on theory, it is often extremely difficult to point to where the fallacy lies, and it is far better to bring forward the evidence of practical knowledge and experience to prove the argument. In the present case we chiefly based our remarks upon the results of very numerous experiments which we happen to know have been made during several years past by the electricians of the British Postal Telegraph Department upon Wheatstone automatic fast speed working. In order to obtain high speed on long circuits, it has been found necessary to introduce "repeaters" at intermediate points, so as to bring the working "K R" within the limits necessary to give the high speed. The apparatus for this purpose is somewhat complex, and in the course of the numerous experiments which have been made, a very great number of trials were carried out with shunted condensers at one or more intermediate points to see whether the division of the line with such condensers would not enable fast-speed working to be obtained without the use of repeaters. The result of the experiments was to clearly indicate that the tendency of such contrivances was to *reduce*, and not to increase, working speed. The actual arrangements tried were much on the same lines as those indicated by Dr. Pupin, though possibly certain of the combinations suggested by the Dr. were not experimented with. We should be the first to congratulate the inventor if he could practically show that he has actually hit upon a method which effects the object which he theoretically believes he has arrived at; but in the absence of the application of the touchstone of experiment we must remain incredulous. We shall, however, look forward with interest to the development of Dr. Pupin's work, and hope that we have been mistaken in our estimate of it. It has been our fortune (or misfortune) on more than one occasion to have to listen patiently to the enthusiastic arguments of inventors, who with apparently perfect logic have conclusively proved their contentions, but in the end the disappointed inventor has nearly always found that the result has not been what he anticipated. Facts are stubborn things; an unfortunate citizen had managed to get in the meshes of the law and to be incarcerated in the county gaol; his legal adviser who had been sent for, and had carefully listened to his client's statement of woes, after a little reflection assured him that he need not alarm himself. "I have carefully considered your statements, and am perfectly satisfied that you cannot possibly be imprisoned for what you have done." The unfortunate citizen did not seem much comforted. "What is the use of your telling me I can't be shut up"; confound it man, "here I am."

New Method of Ship Wiring.

This method, referred to by us in connection with the *La Marguerite* installation, is not so common, although it may be quite as well known as our correspondents assert in their numerous letters on the subject; it is new in the sense that only recently has it appeared in specifications and been carried out in installations generally, and we maintain that even now it is uncommon on steamships. When it was originated, or by whom, it is difficult to determine, and we cannot very well discuss that matter here. We believe it has been used for some time in house installations, but it is not so easily applicable to ship wiring, and hence is rarer in such installations. Messrs. Siemens Bros. have small reason to complain, for they have wired 53 vessels on this system; they have, however, kept it very quiet. On this point we would remark that we would be very pleased to have references to any publications of the system prior to our brief report of the wiring on *La Marguerite*. Mr. Mackie's ship lighting experience does not begin with this vessel; we have known him as an installation engineer for many years, so that if he refers back, as our correspondents have done, he may antedate some, or most, of them. Why did not Prof. Jamieson include the system in his Pocket-book editions of Rules and Formulæ if it was so well-known to him? He has sufficient admiration for the plan, as may be seen by his letter, and it might, therefore, have found space, but Prof. Jamieson's definition of the system is not quite the same as Mr. Mackie's. Our correspondents are evidently not aware that there are different methods, somewhat closely allied,

in using subsidiary switchboards to avoid jointing. Prof. Jamieson and Mr. Ronald Scott refer to the multiple main, and multiple branch, system, in which joints are not altogether avoided. "Multiple switchboards system" is perhaps a better term for the device. It may be carried out partially in some cases, and wholly in others; that is in some cases small groups only are connected back to subsidiary boards, while in others every lamp comes on to a switchboard, not a single branched wire being used, as on *La Marguerite*. We are very pleased to be assured that the system is coming, either wholly or partially, into common use, for we had no idea that it was so extensively used as our correspondents' letters would lead one to suppose. Its employment appears to be of quite recent growth, for in various discussions on ship wiring, both in scientific society papers and recently in our own columns, not a single reference is made to the general use of this system.

Phosphorescence.

At the last meeting of the Chemical Society, Mr. Herbert Jackson contributed some observations on the nature of phosphorescence. The main portion of his address was occupied with an attempt to show that the phenomena of fluorescence, phosphorescence in air on exposure to light, and phosphorescence of substances in a vacuum under the influence of the electric discharge, are of the same nature, namely, a response on the part of the substances to the operation of radiant energy propagated after the manner of light in undulations of short length. In the case of a rarefied tube these undulations proceed from the electrodes, and to them the gas in the tube responds, giving rise to visible light. Some phosphorescent bodies respond to this light, but others require to be affected by the very short undulations to which air is opaque. Such substances, therefore, only phosphoresce in high vacua. These conclusions are based upon a number of experiments made with a "jar spark" in air acting upon phosphorescent substances placed in the appropriate foci of a quartz lens; on the study of the behaviour of such substances outside a vacuum tube provided with a quartz window, and also on their behaviour inside the vacuum tube. A Fleuss's pump was used for producing the vacua. Apart from the conclusions arrived at by Mr. Jackson, his methods of producing phosphorescence are much simpler than those generally employed.

An Application of Electricity to the Extraction of Gold and Silver from Ores.

A curious application of electricity has been made by A. Trug, a Hungarian, by means of which he states the extraction of gold and silver from their respective ores is greatly facilitated. The apparatus in which the extraction is effected depends for its effects partly upon centrifugal force and partly upon amalgamation by means of mercury. Within the apparatus there is a distributing disc which throws out the ore-sludge in such a way that the particles of metal are collected in an annular trough filled with mercury. The great difficulty in processes of this kind is to keep the surface of the mercury sufficiently active, so that no particle of gold can escape amalgamation. Trug does this by connecting the tubes which feed the ore-sludge on to the distributing disc with the positive pole of a current generator, whilst the negative pole is connected with the vessel or trough which carries the mercury.

The Minimum E.M.F. Required to Decompose Electrolytes.

In our issue for June 15th, page 701, we noticed some recent investigations by Nourisson, and stated his conclusions relative to the minimum electromotive force that is required to decompose an electrolyte. The publication of these results in the *Comptes Rendus* has led to some discussion in the physical section of the Paris Academy of Science. Le Blanc claims that in 1891 he obtained results which are practically identical with those of Nourisson, whilst Berthelot considers that both Le Blanc and Nourisson have only confirmed the conclusions at which he arrived in 1882, and points out that their numerical values are practically identical with his. The interest to the Paris Academicians appears to centre round the claim for priority of which, in a general way, French scientists are usually extremely jealous. To us the interest lies in the confidence with which we may now accept figures concerning which there might have been some misgiving. It could hardly happen that two scientists as eminent as Berthelot and Le Blanc, to say nothing of Nourisson, could have arrived at identically wrong results. Berthelot's statement of his 1882 conclusions is worth reproducing on account of its brevity and lucidity. It is as follows: The minimum electromotive force required to decompose an electrolyte is the sum of the heat absorbed by the separation of the acid from the base in dilute solutions, and the heat of decomposition into oxygen and hydrogen of the water by which the acid and base are dissolved, provided that the acid and base are neither oxidised nor reduced, and that the electrodes are not attacked. It is interesting to note that Berthelot's conclusion is independent of any theory of dissociation into ions.

Electricity in Therapeutics.

Electricity has been used for many years in a rule of thumb fashion for stimulating the nutrition of the muscular system. It is quite time the matter were treated more scientifically. In the application of electricity to human diseases, there has always been too much of an appearance of quackery; and the "G.P." usually resorts to it only as a last resource, without having any views or knowledge as to its precise action. Researches like those recently made by Debedat (*vide Arch. d'Electricité Médicale*, March, 1894) are calculated to change all this, and make electricity as certain a remedy as are the mercury compounds in cases of syphilis. The preliminary experiments were wisely made upon animals, rabbits being selected as the victims to science. The various kinds of electrical stimulation used in medical treatment were all tried, and the results of the investigation are now accessible. The groups of "ham-string" muscles were chiefly experimented with; those of the left side being stimulated daily for twenty days, four minutes per diem, and those of the right side being left for purposes of comparison. At the end of the period the animals were killed and the muscles of the two sides removed and weighed. Portions were also hardened, and examined microscopically. The modes of stimulation were as follows:—(1) Induction-coil current: groups of shocks lasting each for one second and followed by one second interval of rest. (2) Galvanic battery current of 2 milliampères with the same periods of stimulation and repose. (3) Static sparks of 2 to 3 milliampères repeated every two seconds. (4) Tetanisation of muscles for four minutes by means of an induction coil without intervals of repose. (5) Steady galvanic battery current for four minutes without intervals of repose. The results showed a gain of 40 per cent. of weight on the stimulated side of the animal with (1) the rhythmic induction shocks, and of 18 per cent. with (2) the rhythmic battery current. The effect of (3) the static sparks was *nil*. The prolonged tetanisation (4) caused a loss of weight. The prolonged steady battery current (5) caused a slight increase of weight. [Adhesions had been formed between the skin and the muscles at the points of application of the electrodes in this last series of experiments]. It is clear from the results of these experiments that the gain in weight of the muscles was due to a true growth of muscle; and that the loss of weight noticeable in certain of the experiments was accompanied by histological evidence of damage to the muscular fibres. Hence Debedat concludes that the most advantageous mode of promoting the healthy growth of muscle by means of electricity is to use an induction coil, and to arrange the periods of contraction and repose so as to approximate to the conditions of a muscle during the performance of rhythmic gymnastic movements, namely, about 30 periods of contraction and 30 periods of rest per minute. Prolonged tetanisation is distinctly hurtful, and this shows that the methods most commonly made use of by ill-informed practitioners and worse informed quacks are entirely wrong.

THE LYONS-OULLINS ELECTRIC TRAMWAY.

The Lyons-Oullins line is the fifth in France to which the system of electric traction by an overhead wire has been applied. The first, from Lyons St-Just to Sainte-Foy was installed by a Lyons maker. The Lyons-Oullins line, which forms part of the system of the Lyons Tramway and Omnibus Company, begins in the very heart of the town at the Place de la Charité, it then follows the Rhone, crosses the Saône at the Pont de la Mulatière, and goes on to Oullins with a maximum gradient of 3·5 in 100, and a length of about 6 kilometres. The line, constructed on the Marsillon system, is double almost throughout its whole length, it has no very sharp curves, but there is a very long incline from the Mulatière to Oullins, thus traction by horses was very difficult and the rate of progression very slow. More than a year ago the Lyons Tramway Company decided to make an alteration on this line, but owing to formalities and delays on the part of the Administration, the work was deferred for a long time. At last, however, the trial trips were made at the beginning of April and the line was then opened for regular service.

The application of electrical traction to this line presents several points of interest which we will touch upon in succession, discussing more fully the electrical part of the subject. We shall begin with an examination of the general problem of the calculation of the motive power required for an electrical tramway with overhead wire, for on this calculation, of course, depends the power of steam engines and dynamos.

Calculation of the Motive Power required for an Electric Tramway.

The periods of departure being fixed in the specification and also the maximum speed, we can deduce a mean uniform speed and make a graphic representation of the vehicles in service. We next calculate the motive power required by each car for making the journey to and fro under these conditions, assuming a resistance to traction of 10 kg. per ton on level ground; 1 kilogramme per ton per millimetre of inclination; and, lastly, making various hypotheses as to the speed of the car on an incline and on level ground. If then, following the contour of the line, we apply the formula expressing the work effected at various points, we can easily construct a polygon, the surface of which, comprised between the axis of the lengths and the various sides, represents the sum of the work effected by one car. We can also on the diagram consider periods of time very near together, and know for each of these moments what motive power is required for each car and what for all the cars together at that moment. We can, for instance, make these calculations every minute, until we arrive at a time after which we find periodically the same figures. We thus find a mean maximum motive power, and a minimum (which may be 0). The figures obtained thus only indicate the motive power that must be applied horizontally at the axles of the cars. To obtain the motive power at the works we must take into account the efficiencies of the various parts of the system; these are the efficiences adopted:

Motors with gearings*	70 per cent.
Line	90 „
Generating dynamo	90 „
Belt and steam engine	85 „

or a mean efficiency of 48·2 per cent. We usually take 50 per cent., and we thus obtain the mean motive power maximum and minimum expressed in H.P. indicated at the cylinder of the steam engine.

Practically, these calculations are very quickly made, since experience has shown that a given number of cars in service require a dynamo giving a certain number of kilowatts, and that this rule is almost independent of the nature of the road. Here are some of these figures:

Generating dynamo ...	60 kilowatts	...	4 cars.
„ „ ...	100 „	...	6 to 7 „

* The efficiency given here is a mean efficiency lower than the maximum efficiency which attains to 85 per cent., for we must take into account the low efficiency at starting.

It is easy to see that these figures can be relied upon, for if on one journey there are steep ascents, there are descents on the return journey for which the car does not absorb any current. The calculations made can evidently be only approximate, for they do not take startings into account. It is assumed that to start on level ground, a car requires as much current as to ascend an incline of 3 in 100 at a speed of 12 kilometres an hour. In any case, the figures obtained by calculation are valuable, as they show how great are the variations of power and how great should be the sensibility of the regulator of the steam engine in order to provide against the sudden changes that occur. It is no rare thing, indeed, in a central electric tramway station to see the needle of the ampèremeter vary suddenly to the extent of 150 ampères in one direction or the other. It is therefore interesting to know the relation between the maximum motive power and the mean motive power. If this ratio is more than two, as is the case with lines having only four or five cars in use, the best steam engine to use is the high-speed engine with a very heavy fly-wheel. A little reflection will soon enable us to perceive the advantage of the high-speed engine over the low speed one in this case. In fact, whatever may be the sensibility of the regulator, its action can only be felt either at the beginning or the end of the course of the piston; thus in an engine working at 250 revolutions the effect will be quicker in making itself felt than in one working at 60 revolutions.

When the ratio of the maximum motive force to the mean is between $1\frac{1}{2}$ and 2, as when from six to eight cars are running, a low-speed engine can be used if it is provided with a very heavy fly-wheel. Above eight cars the best engine to be used for electric traction is a Corliss engine, as sudden variations between the maximum and the minimum are greatly reduced.

I (M. J. Berthon, in the *Revue Internationale de l'Electricite*), have recently been confirmed in the above opinions by a visit to an electric tramway in Belgium. A dynamo of 50 kilowatts (nominal power, 600 revolutions), is worked by a belt by a steam motor making 120 revolutions per minute. The fly-wheel of this engine is extremely small as regards diameter and weight; under these conditions the speed of the motor can easily be seen to vary 50 per cent., and that almost periodically at intervals corresponding to the stoppages and startings of the cars; but as the cars only stop at certain points of the route, the variations in the work to be effected are not so great as if they were stopped at any moment.

It is in accordance with these general rules that the power of the steam engines of the Lyons-Oullins tramway has been determined. It was found that from 120 to 160 steam H.P. were required at the works to work from six to eight cars; under these conditions a steam engine of 150 H.P. would be required, but it would have to be capable of supplying 200 H.P. temporarily in case of accident.

Overhead Line: Establishment of a Return by the Rails.—The overhead line consists of a naked copper wire 8·25 millimetres in diameter, suspended parallel to the track at a height of 6 metres from the ground. The mode of suspension employed all along the line is the transverse system. For this purpose posts are placed opposite one another on each side of the road; these posts are connected at the top by a cable 4·6 millimetres in diameter. This little cable is formed of seven steel wires capable of resisting a strain of 100 kg. per square millimetre. On this transverse wire is suspended the trolley wire by means of special insulated appliances.

For an electrical tramway with overhead wire to have a presentable appearance, the trolley wire must be stretched as tightly as possible, as well as the transverse wires. Under these conditions the posts are subjected at the top to strains tending to bend them; they must, therefore, be extremely rigid.

The posts of the Lyons-Oullins tramway are made of four steel tubes overlapping and welded one into the other. Their dimensions vary according to whether the road is straight or curved; the ordinary posts are 8·8 metres high, and must resist a strain of 350 kg. applied to their upper part without presenting a temporary deflection above 14 millimetres. If the strain is brought up to 550 kg., they must

not show a permanent deflection when once the strain is suppressed.

Dimensions of the Metal Posts of the Lyons-Oullins Tramway.

		Ordinary posts.	Extra strong posts for curves.
Total length		8·80 m.	8·90 m.
1st tube	Length	4·40 m.	4·50 m.
	Internal diameter	160 mm.	154 mm.
	External diameter	172 mm.	172 mm.
2nd tube	Length	1·70 m.	1·70 m.
	Internal diameter	136 mm.	130 mm.
	External diameter	146 mm.	146 mm.
3rd tube	Length	1·50 m.	1·50 m.
	Internal diameter	112 mm.	117 mm.
	External diameter	121 mm.	112 mm.
4th tube	Length	1·20 m.	1·30 m.
	Internal diameter	87 mm.	85 mm.
	External diameter	95 mm.	95 mm.

The posts are buried in the earth for a length of 1·8 to 2 metres; the ground round them is concreted. To give them a more ornamental appearance, they are provided with a cast iron base; rings of iron are also used to cover the joints of the tubes. Lastly, at the top, they are finished off with an ornament in the form of a point. The posts are placed at intervals of 40 metres along the straight roads; along the curves they are closer together.

The sag allowed in fixing the transverse wires is 3 per cent. of the span; that allowed for the trolley wire varies from 38 to 46 millimetres. To fix a post, when once the hole is dug in which it is to be sunk, it is inclined away from the road as much as it will be pulled by the tension of the transverse wire, and in this position it is fixed in the earth.

Besides the metal posts the wire is suspended, particularly in the crossing of La Mulatière, where the street is narrow, to the houses on either side. For this purpose a metal bracket is fixed to the wall with two bolts; this bracket is provided with an India-rubber buffer to prevent it from transmitting to the wall to which it is fixed the vibrations of the transverse wire.

To fix the transverse wire on to the posts, these latter are provided near the top with an iron collar fitted with a tightening bolt. The tension of the transverse wire in certain places where it was necessary that it should be able to vary, is regulated by means of a little insulated tightener.

The insulating blocks sustaining the trolley wire are formed of a bronze clutch about 35 centimetres long, on to which the wire is soldered. The upper claw is terminated by a screw thread so as to receive a bolt, the head of which is encased in insulating material known as the Lieb insulator, after the American manufacturer. The eye thus insulated is prepared to receive a piece of iron forming an axle, to which is attached a cast-iron piece arranged to receive the transverse wire.

When the road is curved the clutch is still used, but it is provided with two curved arms, or one single one, according to the circumstances, and the transverse wire is fixed to their extremities.

At certain points of the road the clutch grasps the two ends of the trolley wires, which are inserted for this purpose into holes drilled into the thickness and then soldered in. In other cases the clutch is provided with attachments for the reception of the wires. At crossings the overhead line is provided with points, by means of which the wheel of the trolley passes from one wire to the other without any difficulty; these points are not of any special interest.

To ensure a good return by the rails, we must not reckon upon the fish-plates, or upon the earth, the return circuit must be entirely metallic. There is no question that has been the subject of more controversy than that of the return circuit for electrical tramways. It is a matter of public interest to have the best possible return, not only as regards the good working of the tramway, but also for the sake of the telephone lines and the water and gas pipes.

At first, all that was done was to connect the two adjacent extremities of the rails together and place at intervals a plate of earth. It was soon found that this plan was defective and that the return must be entirely metallic. This having been carried out, disturbances in the telephone lines have been almost entirely suppressed, and the water pipes and gas pipes are no longer affected. Sometimes very curious electrolytic effects are produced in the return circuits of electrical tramways; thus, in the town of Milwaukee (Wisconsin) the water pipes were very rapidly electrolysed by the tramway current. The idea was then suggested of connecting the rails metallically to these water pipes, which thus acted as a return circuit; all electrolysation then ceased.

To connect the extremities of two rails, a hole 14 millimetres in diameter was drilled in the core. This hole is made with a drill, and not with a punching machine. When the rails are already laid, as was the case at Lyons, a little hand drill is used, worked by a lever and a ratchet screw; we can also use a drilling engine constructed specially for the purpose. This machine is mounted on wheels, which enables it to be easily moved from one place to another. Two men, working the handles of two fly-wheels, can pierce the core of the rail in a very short time. At Lyons, as there was a rail and a counter-rail, it was necessary to drill both.

(To be continued.)

POWER LOSSES IN THE TRANSMISSION MACHINERY OF CENTRAL STATIONS.*

By Wm. S. ALDRICH.

(Concluded from page 23.)

The E.H.P. delivered to the car motors, curve (5), has been obtained by setting off vertical distances, as K, L, from (4), which are uniformly 6 per cent. of the ordinates of (4) as K, N; this per cent. of line losses being the mean already referred to.

The horse-power delivered to the car axle, curve (6), was drawn by deducting 30 per cent. from the measured ordinates of (5), the combined efficiency of the motor and gearing having been taken at 70 per cent. Finally, the ordinates of curve (6) as M, N, represent the horse-power available at the car axle for traction at any particular point within the limits of the preceding curves.

Table II.—Data of Turbine Installation.

Water Supply.	
Flume, diameter in feet	10
Nominal head of water, in feet	18
Hercules Turbines.	
Diameter, in inches	45
Effective area of guide opening, square inches	623
Rated speed, revolutions per minute	110
Commercial Rated Performance, Full Gate.	
Rated discharge of each turbine, cubic feet per minute	8,833
Rated efficiency, full gate and rated speed, in per cent.	80
Rated horse-power, at this efficiency, each turbine	240
Actual Performance at Full Gate.	
Actual discharge, each turbine, cubic feet per minute	8,588
Actual efficiency, 110 revolutions, in per cent.	80·7
Maximum dynamometric horse-power, each turbine	210
Actual Performance, about Half Gate.	
Mean position of speed gate, being the proportional part of the full opening of the speed gate in per cent.	53·3
Actual discharge at critical speed for this gate, cubic feet per minute	5,528
Efficiency, critical speed 100, in per cent.	75·37
Efficiency, rated speed of 110	74·4
Actual dynamometric horse-power of each turbine at the critical speed of 100 revolutions per minute	132·5
Actual dynamometric horse-power of each turbine at the rated speed of 110 revolutions per minute	128·5

* Presented at the Montreal meeting (June, 1894) of the American Society of Mechanical Engineers.

Table III.—Data of Transmission Machinery of Turbine Plant.

Geared and Belted Connections.

Number of teeth on mortised crown gear, vertical shaft ...	49
Number of teeth on jack gear, horizontal shaft	31
Diameter of main driving pulley, on jackshaft, in inches ...	108
Diameter of main driving pulley, on countershaft	66
Diameter of dynamo-driving pulleys (friction clutch) ...	60
Diameter of pulleys on dynamos	26
Main driving belt, extra double, width in inches	45
Dynamo belts, double, in inches	15
Length of main driving belt, in feet	83

Rated Speeds.

Turbine shaft (vertical), revolutions per minute	110
Jackshaft over turbines	175
Countershaft	286
Dynamos	650
Speed of main driving belt, feet per minute	4,950
Speed of dynamo belts	4,300

Distance between Shaft Centre Lines.

Between the vertical shafts of the turbines, in feet	16·5
Between the jackshaft and countershaft	30
Between the countershaft and dynamos	20

Table V.—Performance of Turbines and Dynamos Under Light Load.

Summary of Power Distribution and Efficiency.

With special test car, No. 4, on the two principal grades, 3·64 per cent. and 3·94 per cent., no other car being on the road at that time, August 17th and 18th, 1891.

Grade on which reading was taken	*3·64 per cent.		**3·94 per cent.	
Time and time interval on grade	11-37-30	11-31-45 to 11-39-30	12-8-0	12-6-0 to 12-16-0
Conditions.	Steady.	Mean.	Steady.	Mean.
Speed of turbine shaft	97·0	98·5	97·0	101·5
Gate opening, No. 1 turbine	31·7	30·6	31·0	30·2
„ No. 2 turbine (fixed gate) ..	17·4	17·4	17·4	17·4
Speed of car,† miles per hour	12·4	11·43	11·4	10·62
Power delivered—				
Hydraulic H.P. delivered to turbines ..	190·0	187·0	188·2	184·2
Turbine H.P. delivered to transmission machinery	93·2	88·7	91·4	86·0
H.P. delivered to dynamo	56·1	53·15	55·1	51·9
E.H.P. delivered to line..	48·5	45·9	47·6	44·7
E.H.P. delivered to car motors‡	46·0	43·1	44·8	42·3
H.P. delivered at car axles	34·50	31·92	33·7	31·78
Power lost—				
Turbine friction H.P.	96·8	98·3	96·8	98·2
Transmission machinery H.P.	37·1	35·55	36·3	34·1
Dynamo losses	7·6	7·25	7·5	7·2
Line losses	2·5	2·8	2·8	2·4
Car motor, gearing and axle losses ..	11·5	11·18	11·1	10·52
Total losses, Hyd. H.P. to car axle H.P. ..	155·5	155·08	154·5	152·42
H.P. available at car axle	34·5	31·92	33·7	31·78
Total Hyd. H.P. delivered..	190·0	187·0	188·2	184·2
Proportional parts of full load—				
Hyd. load, per cent. of full-hyd. H.P. ..	36·2	35·7	35·9	35·2
Turbine load, per cent. of full turbine H.P.	22·5	21·4	22·1	20·6
Dynamo load, per cent. of full dynamo output	36·2	34·2	35·5	33·3
Motor load, per cent. of full motor output..	73·5	68·8	71·5	67·7
Percentage distribution—				
Turbine friction, per cent. loss	·509	·526	·514	·533
Transmission machinery friction, per cent. loss	·195	·187	·194	·185
Dynamo, per cent. loss	·040	·038	·040	·039
Line, per cent. loss	·013	·015	·014	·013
Car motor, gearing and actual losses ..	·061	·063	·059	·057
Available power at car axle	·182	·171	·179	·173
Total hydraulic power	1·000	1·000	1·000	1·000
Summary of efficiencies—				
Efficiency of No. 1 turbine	58·7	57·4	58·0	55·8
„ No. 2 turbine	33·8	32·9	34·0	31·4
„ coupled turbines	49·1	47·4	48·5	46·7
Efficiency transmission machinery ..	60·2	59·9	60·3	60·4
Efficiency of No. 1 dynamo¶	86·5	86·3	86·4	86·1
„ line, mean, for given grade ..	94·8	94·0	94·1	94·8
„ car motors, from terminals to car axle	75·0	74·2	75·2	75·1
„ from dynamo terminals to car axle	71·2	69·7	70·8	71·2
„ from Hyd. H.P. to line H.P. ..	25·5	24·5	25·3	24·2
„ from Hyd. H.P. to car axle H.P.	18·2	17·1	17·9	17·2

* On 3·64 per cent. grade car started under normal and almost steady conditions. Record ends without stopping the car.

** On 3·94 per cent. grade car started from a full stop, stopped twice *en route*, and almost stopped at end of grade.

† Mean speeds on grade are exclusive of stops.

‡ Car equipped with two No. 12 Edison S.R. 25-H.P. motors, style B.

¶ 100 kw. Edison railway generator, rated at 650 revolutions per minute.

Weight of car alone 22,000 lbs.; weight of car and load during test, 22,500 lbs.

Plant driven by two 250-H.P. 45-inch Hercules turbines, coupled; one of which, No. 2, is kept at fixed gate opening of 17·4 per cent.

Table VII.

Performance of Turbines and Dynamos under Heavy Load.

Summary of Power Distribution and Efficiencies.

Section in which reading is taken	I.	II.	Total.
Time base of section, hours and minutes ..	10·30—11·01	11·01—11·14	10·30—11·14
Time interval of section, in minutes ..	31	13	44
Speed of turbine shaft, revs. per minute—			
Maximum	113·0	104·5	113·0
Minimum	90·5	78·0	78·0
Mean (integrated)	101·8	93·5	99·4
Gate opening, proportional part of the full opening of the speed-gate, per cent —			
No. 1 turbine, maximum	38·0	41·0	41·0
„ minimum..	6·5	8·5	6·5
Mean (integrated)	23·4	25·5	24·0
No. 2 turbine, maximum	44·0	66·0	66·0
„ minimum..	9·5	16·5	9·5
Mean (integrated)	25·0	38·7	29·1
Power Delivered—			
Hydraulic H.P. delivered to turbine.. ..	182·7	234·0	197·8
Turbine H.P. delivered to transmission machinery	85·1	138·9	101·0
H.P. delivered to dynamos	50·5	95·8	63·7
E.H.P. delivered to line..	38·5	82·0	51·3
„ „ to car motors	36·2	77·1	48·2
H.P. „ to car axles	25·4	54·0	33·7
Power Lost—			
Turbine friction H.P.	97·6	95·1	96·8
Transmission machinery friction H.P. ..	34·6	43·1	37·3
Dynamo losses	12·0	13·8	12·4
Line losses	2·3	4·9	3·1
Car motor and gearing losses	10·8	23·1	14·5
Total losses Hyd. H.P. to car axle H.P. ..	157·3	180·0	164·1
H.P. available at car axle	25·4	54·0	33·7
Total hydraulic H.P. delivered	182·7	234·0	197·8
Proportional Parts of Full Load—			
Hydraulic load, per cent. of full hyd. H.P.. .	35·1	45·0	38·0
Turbine load, per cent. of full turbine H.P.	20·4	33·4	24·3
Dynamo load, per cent. of full dynamo output	14·4	30·6	19·2
Motor load, per cent. of full motor output ..	14·5	24·6	17·2
Percentage Distribution—			
Turbine friction, per cent. loss	0·534	0·406	0·489
Transmission machinery friction per cent. loss	0·189	0·184	0·189
Dynamos, in parallel, per cent. loss	0·066	0·059	0·063
Line losses, mean of total length	0·013	0·021	0·016
Car motor, gearing and axle losses	0·059	0·099	0·073
Available power at car axle	0·139	0·231	0·170
Total hydraulic power	1·000	1·000	1·000
Summary of Efficiencies—			
Efficiency of coupled turbines	46·6	59·4	51·1
Efficiency, transmission machinery..	59·3	69·4	63·1
Efficiency of dynamos in parallel	76·3	85·2	80·5
„ line, mean of total length ..	94·0	94·0	94·0
„ car motors	70·0	70·0	70·0
„ from Hyd. H.P. to line H.P. ..	21·1	35·0	26·0
„ „ „ to car axle H.P.	13·9	23·1	17·1

Efficiencies from Hydraulic H.P.	To line H.P.	To car axle H.P.
Efficiency at half load of dynamos, which is 50 per cent. turbine capacity, or 57 per cent. full Hyd. H.P.	45·0	29·3
Efficiency at full load of dynamos, which is 95 per cent. turbine capacity, or 93 per cent. full Hyd. H.P.	55·2	36·5

Cars equipped with two No. 12 Edison S. R., 25 H.P. motors, style B. Current supplied by two 100 kw. Edison railway generators, rated at 650 revolutions per minute.

Plant driven by two 250 H.P., 45-inch Hercules turbines, coupled. Four 22,000 lb. cars out on road, in service during test.

4.—Power Losses in a Cable Plant.

This test was made on the Druid Hill Avenue Cable Plant, Baltimore, Md., jointly by Mr. Hermann S. Hering and the author, March 29th, 1892, while associated in the department of electrical engineering at the Johns Hopkings University.

A new plan is employed to drive the cable drums by not having them geared together; but, using in connection with each driving drum, a Whitton compensator. This consists of a simple box-train epicylic gear. The idler drum is double, one half of which is mounted loose on the shaft, while the other half is keyed to the same.

The cable drums are placed, one on each side of the rope-drive drum, on the main shaft, and driven through positive clutch couplings. These, as well as similar clutches on the engine shaft, are operated by hand, through compound gear.

In the 11 miles of single track, there are 58 single track curves, making 2,900 feet of curve construction in all.

The power house, at the other end of the line, is a duplicate of the Druid Hill Avenue one.

TABLE IV.—PERFORMANCE OF TURBINES AND DYNAMOS UNDER LIGHT LOAD.

Observed and Mean Values taken from Fig. 3.

Values on the two principal grades, and maximum, minimum, and mean values for the entire trip of the Special Test Car, No. 4. August 17th and 18th, 1894.

Grade on which reading was taken.	3·64 per cent. up.		3·94 per cent. up.		3·64 per cent. down.	Entire car route.		
Time and time interval on grade.	11—37—30.	11—31—45 to 11—39—30.	12—8—0.	12—6—0 to 12—16—0.	12—300.	11—30 to 12—45.		
Conditions.	Steady.	Mean.	Steady.	Mean.	No load.	Maximum.	Minimum.	Mean.
Coupled Turbines.								
Efficiency	49·1	47·4	48·5	46·7	22·3	49·5	− 4·88†	34·4*
Total turbine friction H.P. ...	96·8	98·3	96·3	98·2	97·1	111·5	93·8	98·87
Turbine shaft revolutions per minute	97·0	98·5	97·0	101·5	103·0	122·0	96·0	103·5
Variations of power from hydraulic H.P. at station to electrical H.P. delivered to car.								
Hydraulic H.P.	190·0	187·0	188·2	184·2	124·9	195·0	116·3	150·50
Turbine H.P.	93·2	88·7	91·4	86·0	27·8	95·6	− 5·67‡	51·75
E. H. P. at station	48·5	45·9	47·6	44·7	0·0	63·9	0·0	...
E. H. P. at car	46·0	43·1	44·8	42·3	0·0	59·4	0·0	...

* Calculated from integrated means of horse-power curves for entire run. All other values in this column are integrated means.

† No. 2 turbine kept at fixed gate opening of 17·4 per cent. The negative value of the turbine H.P. arises from this turbine driving the No. 1 turbine at the sudden change of load indicated; so that the No. 1 turbine output, the total turbine output, and the efficiency, are all negative.

TABLE VI.—PERFORMANCE OF THE TURBINES AND DYNAMOS UNDER HEAVY LOAD.

Observed and Mean Values from Fig. 5.

Values on the two principal portions of the run; and maximum, minimum, and mean values for the entire run, August 20th, 1891.

Section in which reading is taken	I.	II.	Total.
Time base of section, hours and minutes ..	10·30—11·01	11·01—11·14	10·30—11·14
Time interval of section, in minutes ..	31	13	44
Efficiency, maximum	58·0	69·0	69·0
„ minimum	26·0	39·0	26·0
Mean (from mean H.P.'s)	46·6	59·4	51·1
Turbine friction H.P.			
Maximum	110·0	99·0	110·0
Minimum	82·0	86·0	82·0
Mean (integrated)	97·6	95·1	96·8
Speed of turbine shaft, revs. per minute.			
Maximum	113·0	104·5	113·0
Minimum	90·5	78·0	78·0
Mean (integrated)	101·8	93·5	99·4
Hydraulic H.P., maximum	230·0	300·0	300·0
„ „ minimum	140·0	162·0	140·0
Mean (integrated)	182·7	234·0	197·8
Turbine H.P., maximum	132·0	208·0	208·0
„ „ minimum	37·0	64·	37·0
Mean (integrated)	85·1	138·	101·0
Electrical H.P., maximum	76·0	124·0	124·0
„ „ minimum	0·0	40·0	0·0
Mean (integrated)	38·5	82·0	51·3

The above particulars are taken from the *Street Railway Journal*, March, 1891, which contains a full and illustrated description of the "Baltimore Cable Road" and the Druid Hill Avenue power house.

The test was made under the ordinary working conditions of the road, the usual daily traffic and operations not being interfered with in the least during the normal running time of 24 hours. The plant consisted of two Wetherill-Corliss type of engines, rated at 414 H.P., at 60 revolutions, 80 lbs. boiler pressure, and ¼th cut-off. Rope-driving is used to transmit the power from the engine shaft to the cable-driving shaft. Only one engine was run during the test. It was fitted with pantograph reducing motion, and two Thompson indicators. The method of indicating the engine was to take simultaneous cards from each end of the cylinder every two minutes. The pencil was kept on for a single revolution only, and the same card was used for five consecutive observations, at two-minute intervals each. New cards were put on every 10 minutes, so that each card contained a record of five single diagrams from one end of the cylinder. Sometimes the pencil, at one end of the cylinder, would be left on the card for three or five minutes, while the single cards were taken from the other end as usual. On comparing the two cards it was found that the mean obtained from the five single cards was practically the same as that from the one continuous card. The method therefore followed, in taking the cards and averaging them, gave a satisfactory value of the mean indicated horse-power of the engine during the interval. The sum of the areas of the five single diagrams was divided by five, giving the mean area, which divided by the mean length gave the mean effective pressure for the 10-minute interval.

The frictional losses of the engine, drum, and cables, were determined by running the engine with only that part of machinery attached, of which it was desired to obtain the frictional horse-power. It will be noticed that the sum of the individual friction horse-powers of the large and small cables is not equal to that required to drive the two together. This shows an increase in the friction of the transmission machinery and through the rope drive, a result which is to be expected when the transmitted load is increased and the two cable-driving shafts are operated as one.

The power necessary to drive the cable under no load and at various speeds, was obtained by a special test; from the plotted results of this run it appears that the cable friction horse-power varies almost directly with the speed at which the cable is running.

It is the extent of curved track and the steep grades on the road which no doubt make the efficiency of the cables so low; for, as will be seen by referring to the summary of efficiencies, only 45·9 per cent. of the power delivered to both cables is available for use in propelling the cars.

The data and particulars involving the power losses in the transmission machinery are tabulated below:—

TABLE VIII.—DATA AND PERFORMANCE OF ENGINE AND CABLE.

Dimensions of Engine.

Diameter of cylinder	28 in.
Stroke of piston	5 ft.
Piston stroke to release (proportional part of stroke)	100·0 stroke.
Piston stroke to exhaust closure ...	... head, 92%; crank, 92%
Clearance from card	head, 2·7 %; crank, 3·0 %.

Dimensions and Data of Transmission and Cable Machinery.

Driving drum, on engine shaft	... 8 ft. diameter, 8 ft. 4 in. face.
Main shaft drum	... 24 „ „ „
Number of ropes in rope-drive	32
Main shaft, between clutch couplings	18 in. diameter.
„ „ „ „ and the cable-driving drums	15 in. diameter.
Cable drums, down-town	10 ft. 6 in. diameter.
„ „ up-town	16 ft. diameter.
Cable speeds, down-town	7½ miles per hour.
„ „ up-town...	11½ „ „

Data from Test.

Date of test	March 29th.
Duration of test, normal running time of engine	21 hours, 52 mins.
Mean boiler pressure, pounds per gauge	80·96 lbs.
Ratio of boiler to initial engine pressure	88·3 per cent.
Mean speed of engine	60·53 revs. per min.
Mean piston speed	605·3 ft. per min.
Average mean effective pressure	head end, 20·6 lbs.; crank „ 22·4 lbs.
Mean total indicated horse-power	241·7 H.P.
Mean back pressure in ports	head end, 1·91 lbs.; crank „ 1·43 lbs.
Mean back pressure of compression	head end, 21·0 lbs.; crank „ 22·0 lbs.

TABLE IX.—SUMMARY OF POWER DISTRIBUTION AND EFFICIENCY OF CABLE PLANT.

Power Developed and Delivered.

H.P. developed, cars on, maximum 6.30 p.m.	342·2 H.P.
„ „ „ minimum 5.04 a.m.	156·0 H.P.
„ „ „ mean (of run)	241·7 H.P.
H.P. developed without cars on, but with both cables, drum, and engine friction, maximum at start	174·6 H.P.
H.P. developed without cars on, but with both cables, drum, and engine friction, minimum	148·8 H.P.
H.P. developed without cars on, but with both cables, drum, and engine friction, mean	152·35 H.P.
H.P. developed without cars on, but with down-town cable, drum, and engine friction, mean	124·2 H.P.
Same, but with up-town cable, drum, and engine, mean	69·0 H.P.
Same, but with drum and engine only, mean	47·45 H.P.
Same, but with engine only (engine uncoupled), mean	29·15 H.P.
H.P. delivered by engine shaft	212·55 H.P.
H.P. delivered by main driving shaft from clutch couplings	194·25 H.P.
H.P. delivered by both cables to cable car grips	89·35 H.P.
Friction H.P. of both cables and additional shafting required by same, mean	104·9 H.P.
Friction H.P. of both cables, alone, mean	98·3 H.P.

Power Lost.

Engine friction H.P.	29·15 H.P.
Drum friction	18·30 H.P.
Up-town cable friction	21·55 H.P.
Down-town cable friction	76·75 H.P.
Shafting, due to mean load on both cables	6·60 H.P.
Total friction H.P.	152·35 H.P.
Mean available H.P. delivered to cars	89·35 H.P.
Mean total indicated H.P. developed by engine	241·70 H.P.

Summary of Percentage Distribution of Power.

Percentage lost in engine friction	12·10 per cent.
„ „ drum friction	7·60 „
„ „ up-town cable friction	8·90 „
„ „ down-town cable friction	31·80 „
„ „ shafting (due to use of both cables)	2·70 „
Percentage available power at cars	36·90 „
Total power developed by engine	100·0 per cent.

Summary of Efficiencies.

Mechanical efficiency of engine	87·9 per cent.
Efficiency of rope-drive transmission, from engine shaft to main shaft clutch couplings	91·3 „
Efficiency of both cables and cable-driving drums, from main shaft clutch coupling	45·9 „
Efficiency of the cable plant, from the I.H.P. of engine to power available at cars	36·90 „

5.—POWER LOSSES IN TRANSMITTING THROUGH A COUNTERSHAFT.

These tests were made to determine the losses in the usual method of driving dynamos; namely, through two belted connections and a countershaft. They were made jointly by Mr. Clement R. Jones and the author, in the Mechanical Engineering Department of the West Virginia University, in March, 1894.

Two sets of tests were made:

(1) To determine the engine friction.

(2) To determine the transmission machinery friction.

1.—*In the engine friction tests*, 30-minute runs were made, and indicator cards and speeds of engine taken every minute. The value of the engine friction under load, is the mean of four 30-minute runs, with water-cooled Prony brake and platform scales for measuring the power, with minute observations, as in the first case. The results are given in next column.

TABLE X.—DATA AND PERFORMANCE OF ENGINE.

Dimensions of Engine.

Engine, Wheelock, rated horse-power, at 75 revs., 80 lbs., gauge ¼ cut-off	40
Diameter of cylinder	11 in.
Stroke of piston	30 in.
Crank shaft, crank bearing	4½ in. diameter, 11 in. long.
„ outward bearing	4½ in. diameter, 11 in. long.
Band wheel; diameter on crown	96⅝ in.; face, 17 in.

Engine Performance.

Engine running free—column (*a*).
Engine running under Prony brake load—column (*b*).

	(*a*)	(*b*)
Time interval of run, minutes	30	30
Corrected mean boiler pressure	76·00	75·70
Mean revolutions, per minute	74·93	71·18
Mean indicated horse-power	2·77	17·18
Mean Prony brake horse-power	0·00	14·57
Engine friction horse-power	2·77	2·61
„ „ per cent.	100·00	15·18
Mechanical efficiency of the engine, per cent.	0·0	84·82

2. In the transmission machinery friction tests, two separate runs were made, one without, and the other with

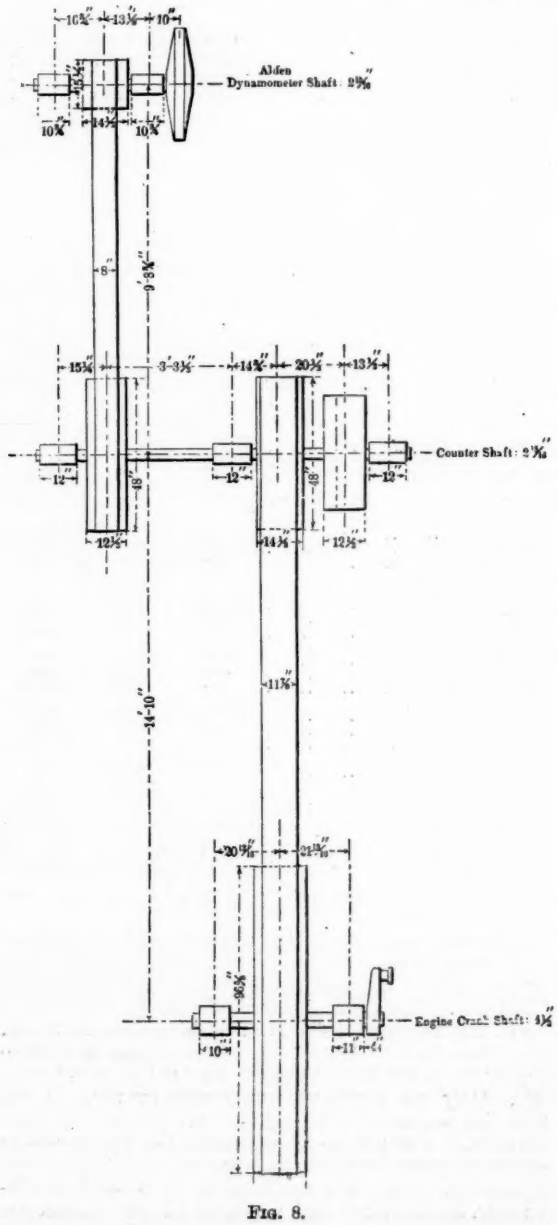


FIG. 8.

leather covering on dynamometer pulley, as noted in the following table under (*c*) and (*d*) respectively. The power was transmitted through a countershaft and absorbed by an Alden dynamometer, as shown in fig. 8, on which the principal dimensions are also given.

It was possible to maintain a very steady load on the engine by means of the Alden dynamometer, and its constant was carefully determined and allowed for in the calculations. It is a 32-inch 50-H.P. dynamometer, especially designed and constructed for use with high-water pressure at high speeds; but during this test it was worked far below its limit, as small powers only were absorbed. Its position in the test is that which a dynamo would occupy in the ordinary electric light plant, driven by a slow-speed engine. It is believed that tests of this character will serve to show the ordinary losses in such installations.

Indicator cards and speeds of engine and dynamometer shafts were taken every two minutes. The engine friction horse-power tabulated for (*c*) and (*d*) were taken from a curve plotted from the previously recorded results, on the usual assumption that it varies directly as the speed, regardless of the load.

TABLE XI.

DATA AND PERFORMANCE OF THE TRANSMISSION MACHINERY.

Dimensions and Data.

Band wheel of engine—diameter on crown ...	96⅜ in.; face, 17 in.
Countershaft pulleys, driven—diameter on crown	48 in.; face, 14½ in.
Countershaft pulleys, driver—diameter on crown	48 in.; face, 12½ in.
Dynamometer pulleys (*c*) bare cast iron—diameter on crown	15¼ in.; face, 14½ in.
Dynamometer pulley (*d*) covered with Shultz patent leather covering — diameter on crown	15½ in.; face, 14½ in.
Main driving belt, light double, oak-tanned ...	11⅞ × ⅛ in.
Dynamometer belt, single, oak-tanned	8 × 7/32nds in.

Transmission Machinery Performance.

Plain cast-iron pulley on dynamometer—column (*c*).
Shultz patent leather covering on dynamometer pulley—column (*d*).

	(*c*)	(*d*)
Time interval of run, minutes	60·	30·
Corrected mean boiler pressure	59·29	64·5
Mean revolutions per minute, engine	67·0	68·25
" " " dynamometer ...	402·60	417·06
Calculated speed of dynamometer, ratio	6·34	6·235
" " " speed	424·0	425·5
Loss in speed, from engine to dynamometer shaft...	22·2	8·44
Slip of belt, per cent. of calculated speed	5·23	1·98
Tension at which belts were laced and run, average of initial, and final tensions on belts—lbs. per square inch:—		
Main driving belts	40·	80·
Dynamometer belt	75·	135·
Mean indicated horse-power	19·122	13·210
Engine friction, horse-power (from plotted curve)...	2·50	2·54
Horse-power delivered to transmission machinery...	16·622	10·670
Dynamometric horse-power absorbed	15·275	9·960
Horse-power lost in transmission machinery	1·347	0·710
Frictional loss per cent. engine	13·06	19·23
Frictional loss per cent. transmission machinery	8·10	6·65
Efficiency per cent., engine	86·94	80·77
Efficiency per cent. transmission machinery ...	91·90	93·35

LEGAL.

WOODHOUSE & RAWSON UNITED, LIMITED.

PUBLIC INQUIRY BEFORE MR. REGISTRAR HOOD.

(*Continued from page* 10.)

THE public inquiry into the promotion and management of this company was proceeded with on Thursday, the 5th inst., before Mr. Registrar Hood, at the London Bankruptcy Court.

Mr. T. H. LAMBERT was called and examined by C. J. STEWART, the Official Receiver. He said that he was a director of Woodhouse and Rawson, Limited, and was appointed one of the liquidators of that company. It was the fact that the liquidators had been unable to realise shares interests of the old company, amounting to £69,000, in the Electric Manufacturing Company, the Electric Supply Company, and the Automatic Machine Company. He was aware that an action had been commenced by the Edison & Swan Company early in 1890, but he had nothing to do with the conduct of the case or with the settlement which was eventually arrived at in March, 1892. As a director of the old company, the prospectus of the United Company came before him, but it was not until after the issue of the prospectus that his attention was called to the paragraph which stated that the audited balance-sheet for 1888 showed profits, £21,440. He understood that the negotiations between the two companies were carried on by the managing directors, Mr. F. L. Rawson and Mr. Hoster, who were also charged to procure the valuations of the assets. He could not say whether he saw the valuations or not, but it would not surprise him to hear that the patents were valued at £160,000. He had always heard that the patents were very valuable.

Mr. STEWART asked whether the Limited Company had ever realised anything for any of their patents?

The WITNESS replied that they did not endeavour to sell their own patents, and moreover the Limited Company had only been in business two years when it was absorbed.

In answer to Mr. PILLING, the WITNESS said that he took an active part in the affairs of the old company, but he had nothing to do with fixing the estimated profits for 1889 at £75,000. It was true that this was the estimate of the vendor company, but he could not say whether it was brought before the board in their capacity of vendors, the transaction having happened six years ago. As one of the vendors, he of course adopted the estimate, but he could not fix any person with the responsibility of it.

Mr. PILLING observed that he had put the same question to each director who had been called, and they all declined to accept the least responsibility in the matter. He was beginning to wonder whether the figure of £75,000 would not turn out to be a printer's error.

The WITNESS said it was certainly not a printer's error.

By the OFFICIAL RECEIVER: It appeared from the minutes that on September 17th, 1890, an account was submitted by Mr. F. L. Rawson in respect of his special services from January to July, 1889, and that the account, which amounted to £10,000, was then approved.

He (witness) was of opinion that this referred to Mr. Rawson's remuneration for floating the Elmore companies, out of which a large profit had been made. He did not think Mr. Rawson received anything in connection with the promotion of the United Company.

By Mr. PILLING: The arrangement was that Mr. Rawson was not to be paid at once, otherwise the estimated profits would have been reduced by £10,000. The question of releasing the guarantee fund of £75,000 was discussed in September or October, 1890, after the appearance of the first balance-sheet of the United Company. So far as he remembered, the contention of the liquidators was that, in view of the large profit which had been realised by the new company, the fund was no longer required, and that they were entitled to have it returned.

By Mr. F. L. RAWSON: He was not aware of any minute of the board instructing the valuers, and supposed that the instructions were given by the managing directors. He could say from his own knowledge that plenty of good work was being done by the manufacturing company, and his opinion was that it would prove a very valuable business. After the liquidation questions arose between the two companies, owing to Mr. Rawson wanting to secure as much as possible for the United Company, and to "squeeze the last penny" out of the Limited. Mr. F. L. Rawson asked the witness, as a director of four companies, whether he had ever known a board so careful of the interests of the shareholders as that of the United Company. His Honour observed that the witness could not be expected to admit that he had been careless in the case of other companies. The witness replied that great care was certainly exercised by the directors. He was aware that Mr. Rawson had done his best to obtain a satisfactory settlement with the founders. The contract for the Elmore patents was originally obtained by Mr. Rawson personally, and when the shares became of value they were given up by him to the old company without consideration. In witness's opinion, the Universal Automatic Company would have been a great success but for the arbitration proceedings. It was one of the earliest companies of the kind, and had a large number of boxes out which were all making money. He had heard Mr. Rawson say that he was not acting fairly to himself and his family in sacrificing his interests in favour of the company.

By H. G. RAWSON: The return of the guarantee fund was opposed by Mr. F. L. Rawson, who wished to retain it for the benefit of the United Company. The proportion of founders' shares held by Mr. F. L. Rawson was very small.

Mr. PHILIP RAWSON, the next witness, said that he was not related to the other gentlemen of the same name who were connected with the company. He first became connected with the business in 1885, when he advanced a sum of £2,000 to the partnership of Woodhouse and Rawson, and he afterwards joined the company in order to guard his interests. He had acted as a director of the Woodhouse and Rawson Manufacturing Company, Limited. He could not exactly say what had become of his £2,000, but he supposed it had merged into the limited company, in which he received 540 shares, which, he believed, were given to him as security for his advance of £2,000. He took no part whatever in the promotion of the limited company. He did not press for the return of the loan, as he wished to be lenient in the matter. Although he was a shareholder in the old company, he did not receive a copy of the report of Mr. Pixley upon the affairs of the company at the date of the transfer of the business. He was not aware that at June 30th, 1889, after allowing for the purchase-money received from the United Company, the accounts of the Manufacturing Company showed a deficiency of £44,000, and that the trial balance-sheet of December, 1888, disclosed a sum of £34,936 standing to the debit of profit and loss account. He agreed to join the board of the United Company, but did not attend any of the preliminary meetings, although shortly before the prospectus was issued he went carefully through the whole matter. He did not, however, make any independent enquiry into the value of the patents acquired by the company for £85,000, as it was a subject upon which he was entirely ignorant. He considered that the business of the company was to be partly industrial and partly financial, and was of opinion that it was within the province of the company to promote any other company connected with electricity, the fullest powers for doing so being provided by

the articles of association. In fact, under those articles, the directors had powers to promote public companies for the purpose of acquiring any property which, in their judgment, might be calculated to benefit the United Company. Possibly this branch of the company's operations was not so clearly brought out in the prospectus as it should have been; but in his opinion sufficient reference was made to it to justify business of that kind being entered upon. At a meeting of the board held on August 1st, 1889, it was resolved to send a circular to the applicants for shares, informing them of the retirement of Sir John Coode, Sir A. L. Cappel, and Colonel Howard Vincent, together with the reasons for their secession, and offering to return the application money, if required. It was the fact that the circular which was issued on the following day did not in terms refer to the return of the money, but the applicants would be aware that they were entitled to the return of their money at any time before the shares were allotted. The circular was despatched on Friday, August 2nd, the following Monday being Bank Holiday, and the allotment was proceeded with on the following Tuesday.

Mr. STEWART: So that any applicant who was away from his office or other address on the Saturday, was not allowed very ample time for his withdrawal?

The WITNESS admitted that that was so. He could not say that he was aware of the connection of Mr. F. L. Rawson and Baron Grant with the Phœnix Trust Company, Limited. He did not think that Baron Grant had ever been consulted with reference to the promotion of the United Company. He was unable to throw any light upon the minute of January 21st, 1892, by which instructions were given to the managing director that all business with the Phœnix Trust Company, or any other financial adviser, should cease. It appeared from the books that a number of Elmore shares were transferred to the Phœnix Trust in August, 1891, but he was not aware that a circular had been issued by the limited company "puffing" those shares. He (witness) and Mr. F. L. Rawson were appointed a committee to carry out the financial arrangements in connection with the formation of the International Okonite Company, but he could not now recollect anything about the arrangements which were made. It appeared that a sum of £37,000 was credited as profit on the promotion of that company, but he (witness) had nothing to do with the application for shares to the extent of £40,000 by the United Company. The result of this was that a great deal of the profit came back to the United in paper instead of in cash. The balance-sheet of 1891 was as regarded the financial part of the business for 13 months, and as regarded the industrial portion for 11 months. He did not think that the financial account was extended in this way to enable the profit of £35,000 made on the promotion of a company to acquire the Epstein patents to be included in the balance-sheet. He did not remember whether, before the balance-sheet was issued, and dividend declared, he made any enquiry as to the number of shares which had been subscribed for by the public in the company referred to. He was not aware that up to the present time shares to the extent of £300 only had been taken up. About £16,000 had been expended by the company in connection with the patents. In the same balance-sheet shares in the Phœnix Trust of the nominal value of £25 were appreciated to nearly £15,000. He could not say whether the latter sum could have been obtained for the shares, and the directors might have been a little too sanguine as to their value. He did not remember seeing a report by Messrs. Trevor, Pilling & Co., showing a loss of £1,984 for the eleven months ending May 31st, 1891, on the Manchester business, and one of £11,101 on the Kidsgrove trading. He was aware, however, that the industrial business was at that time showing unsatisfactory results.

Mr. STEWART said that he had been unable to find any record of the reports in the minute book of the company, but it appeared from a letter written by the secretary that the reports had been brought before the board at a meeting at which witness was not present.

The WITNESS, continuing, said that if he had seen the reports he should certainly have dissented from the statement made at the general meeting of November, 1891, that the businesses were prospering. He did not think the company had suffered from "tightness" of money, but he admitted that various sums had been borrowed from time to time at rates of interest ranging from 6 to 10 per cent., this course being preferred to making a further call on the shareholders. He considered that in 1891 the company had a working capital of £67,000. It appeared from the minutes that a sum of £28,000 was advanced to the managing director for a period of three months, it being part of the arrangement that he should take up preference shares in the company at a premium of 5s. per share. In pursuance of this arrangement 2,619 shares were allotted to Mr. F. L. Rawson, 1,000 to Mr. W. S. Rawson, 1,000 to Mr. H. G. Rawson, and 1,000 to Mr. G. North.

Mr. STEWART: Is it not rather curious that a company should advance money to one of its directors to enable him to purchase shares?

The WITNESS admitted that the transaction required explanation, but stated that he was not able to give it.

Mr. STEWART suggested that the arrangement was entered into in view of the rule of the Stock Exchange not to grant a quotation until a certain number of shares were held by the public, and asked whether witness considered this a proper transactiou for the company to carry out.

WITNESS replied that he could not answer the question, as he did not know what the circumstances were. So far as he could gather, the sale of the shares was a perfectly *bonâ fide* one.

Mr. STEWART: Does it not look like an attempt to ride through the rule of the Stock Exchange?—The witness admitted that it did. Personally, he could never understand why the company did not obtain a quotation. He should not object to the transaction if the company obtained the benefit of it, and it would undoubtedly be a benefit to have an official quotation. He resigned his seat on the board on September 14th, 1892. His reason for doing so was, that he found himself in ill-health, and unable to attend weekly at the meetings of the board and thoroughly grasp all the details of the business. He had invested £4,000 in the old company, and agreed to transfer his holding to the new one. His connection with the Rawson businesses arose from his having in 1888 given a guarantee to the bank for £2,000 in conjunction with Sir Leopold M'Clintock. The matter was afterwards converted into a loan to the Limited Company, on which he received 5 per cent., and he afterwards received shares as security.

By Mr. STIRLING: He did not apply for any shares in the new company. He was present at the meeting at which the directors went to allotment.

Mr. STIRLING: Would you be surprised to hear that you then allotted yourself 400 shares?

The WITNESS said that he should be surprised to hear it. After referring, however, to the allctment book, he explained that he now remembered that the shares of the new company were only £5 shares, and that it was to make up the difference in amount that further shares were allotted to him.

By Mr. PILLING: He could not say who agreed the entries in the managing directors' account, and, so far as he was aware, no instructions were given by the finance committee to the book-keepers.

In answer to Mr. H. G. RAWSON, the WITNESS said that, from his knowledge of the Stock Exchange, he should say that Mr. F. L. Rawson was acting within its regulations in applying for shares in the manner referred to. He remembered Sir A. J. Cappel expressing himself as satisfied with the certificates given by the valuers.

By Mr. EVE: He had never sold or dealt with any of his shares. During the time he was a director he had no reason to doubt the truth of the statements contained in the prospectuses and circulars issued by the board.

Admiral Sir LEOPOLD M'CLINTOCK was next called and examined by the OFFICIAL RECEIVER. He stated that he had no interest in the old company beyond the fact that he held 200 shares as security for a loan. He held 40 shares in the Manufacturing Company, but had never received any dividends on them. He had acted as vice-chairman of that company, which was only a small concern. He was not aware that in 1888 the Manufacturing Company owed Woodhouse and Rawson, Limited, £33,574, or that the goodwill was put down at £37,000. He was not aware that at December, 1890, the accounts of the Manufacturing Company showed a deficiency of £70,000. In August, 1889, he was requested to fill one of the vacancies caused by the retirement of the three directors, and consented to do so. He understood that the business of the company was to be both industrial and financial, but mainly the former. Personally he was in favour of the development of the industrial rather than the financial branch of the business. He did not go into the question of the value of the properties to be acquired by the company at any length, as he was assured that the matter had been thoroughly discussed by the directors who joined the board before he did. He did not attend the meeting at which the shares were allotted. He resigned his seat on February 28th, 1891, because he felt that the financial business was getting so big that it was carrying him out of his depth. He had also other pressing demands on his time, both as a brother of the Trinity House and as a member of another financial concern. His retirement was certainly not due to any distrust of the stability of the company.

By Mr. H. G. RAWSON: Although he did not personally make a thorough investigation into the statements contained in the prospectus, he satisfied himself to the best of his ability that they were correct.

Mr. A. L. FOLEY, who was next called, stated that he had been employed in the secretary's office. He could not throw any light upon the way in which the Elmore shares were disposed of to the Phœnix Trust, nor as to how the Trust disposed of them. All he knew was that he was induced to buy 1,000 of the shares himself, and that he had them still.

Mr. W. T. STUTCHBURY, the next witness, said that he was appointed secretary to the company in 1890. Within two or three months of his joining the company he came to the conclusion that the industrial part of the business had been neglected, and he gathered from the information he obtained that it had been conducted, on the whole, at a loss. He was of opinion that the company needed "backbone," and he urged upon Sir Rawson Rawson the necessity of developing the industrial business. Sir Rawson Rawson, however, said that the directors looked to the financial business for the greater part of their profits. He (witness) expressed the same opinion to the managing director, and later on to Sir John Stokes and Mr. Samuel Pope. Up to 1890, the profits derived from the two branches of the business were not distinguished; but he had that done. So far as he could recollect, the trial balance-sheet which he took out for 1891 showed a loss of about £15,000, without taking account for anything that had been brought forward. He was not aware that this balance-sheet was brought to the knowledge of the auditors, and did not know where it was.

Mr. OWEN, the manager of the Kidsgrove Works, was formally called, but no questions were put to him. The Court then adjourned.

The enquiry was resumed on Friday last, the 6th inst.

Mr. SAMUEL POPE, Q.C., was called and examined by Mr. C. J. STEWART, the Official Receiver. He said that he was not one of the original directors, but was appointed on August 5th, 1889, together with Sir Rawson Rawson and Sir Leopold M'Clintock. He was not a party to any prospectus which was issued prior to his joining the board. At the first meeting he attended he enquired whether proper investigation had been made into the properties, and he was assured by Lord Aberdare that it had. He did not enquire whether the profits shown on the 1888 balance-sheet of the old company had been

realised or not, and was not aware that a qualifying report had been added by the auditors. He was informed by Sir John Coode that he was retiring because he was not satisfied with the amount of the applications for shares. He (witness) understood that the business was to be of a mixed character, and that although the industrial branch was to be the "backbone" of the business, it was expected that a large amount of profit would be derived from the promotion of electrical companies. The mistake made by the directors was in believing that the "boom" in electrical companies would be perpetual. He was not aware that certain patents which the company was to acquire had lapsed long before 1889. He had no doubt that the opinion of competent experts was taken as to the value of the patents. He was aware of the proceedings instituted by the Edison & Swan Company to restrain the United Company from manufacturing the incandescent lamps. He was appointed chairman of the International Okonite Company. A cheque for £30,000 was paid by this company to the United Company on account of promotion money. The cheque was held over for a week at the request of the Okonite Company, but witness did not know that in the meantime the United Company applied for shares through nominees, and that a portion of these application monies was used to meet the cheque. The balance-sheet of 1890 included a sum of £88,106 in respect of profits made in the financial business, out of total profits amounting to £109,000. It was in 1892 that he first became aware that there was a great leak in the industrial business. He was present at the meeting of shareholders at which it was decided to return the guarantee fund, and he thought that step was beneficial to the new company. The liquidators, according to the balance-sheet, were entitled to a credit of £42,000, and the result of the negotiations was that a sum of £12,000 was deducted from the total amount due. In his opinion shareholders were entitled to claim their share of the profits shown in the balance-sheet, and the directors could not refuse to credit them with these profits. He believed the Okonite was now a prosperous company, but he had no connection with it at present, the American shareholders having turned all the English directors out. He considered that the Epstein shares would still be very valuable if money could be found to work the patent. It was the fact that during 1890 the company was continually borrowing money, owing to the directors' aversion to making a call on the shares. Witness was not aware that a loss of £15,000 had been made on the industrial business at the time when the dividend of 1892 was declared. In the debenture stock prospectus issued in February, 1891, it was stated that the proposed stock would, after the existing stock had been paid off, become a first charge on the entire undertaking. The stock had not become a first charge, as the original stock had not been paid off.

By Mr. PILLING: His interest in the old company was £1,498, which he transferred to the United, subsequently applying for a further £250 worth of shares in order that there might be no doubt as to his having duly qualified as a director. His reason for joining the board was that, like others, he had caught the electric fever. He was certainly not aware from the first that an exorbitant price had been paid by the company for the businesses which it acquired.

The proceedings were adjourned to July 10th.

The enquiry into the affairs of this company was resumed on Monday, when Mr. W. T. STUTCHBURY, formerly secretary to the company, was examined, and said that he had expressed his opinion to the directors that the business was not being properly managed, but generally his suggestions were politely ignored.

Sir RAWSON RAWSON stated, in reply to Mr. STEWART, Official Receiver, that he was elected a director on August 5th, 1889, and first attended a board meeting on the following day. He took no part in the preparation of the prospectus, and had never seen it before he joined the board. He had never discussed the formation of the company with his son. He was not interested in any way in Woodhouse and Rawson, Limited, or in any of the subsidiary companies. He was interested in another electrical company, but that had no connection with his son's companies. He had no recollection of saying, with reference to the financial part of the business, that where the company had previously brought out one company, it would probably in future bring out 10. His recollection of what he stated was not that the chief portion of the business of the company would consist in bringing out companies, but in introducing patents and working inventions. He did not go minutely into the accounts of the Woodhouse & Rawson Companies. In certain departments of the industrial business there was a profit shown on the accounts. Profits made for the year ending June 30th, 1890, amounting to £109,000 odd, ought not, in his opinion, to be regarded as exceptional. Those profits might have been repeated but for the Baring failure and the financial depression which followed. In his opinion the credit of the company had suffered through attempting to carry on a dual business, consisting of financial and industrial branches.

The enquiry was adjourned to the 20th inst.

BRASYER *v.* HARNESS AND OTHERS.

ON Thursday morning, last week, the hearing was continued.

Mr. SAMUEL JOSEPH MACKIE, science correspondent of the *Standard*, examined by Mr. AVORY, said he had experimented on one of the Harness belts. He had worn one for nine months. He did not form any permanent opinion of the belt, if the counsel meant to enquire as to its curative qualities. Witness felt some difficulty on the point, because some time since he withdrew from a prospective investigation, and he notified the fact to the principal papers in London. With regard to the result of his experiments, he found that owing to the texture of his skin, witness only obtained about 3 micro-ampères.

Further questioned by Mr. AVORY, WITNESS said he had ascertained no physiological results by his experiments. But upon a skin more moist than his own, the generation of electricity would be greater.

Cross-examined by Mr. WITT: An article or report, purporting to be from your pen, on Harness's establishment, appeared in the *Standard*?—I think not.

Was it in the *Westminster Gazette*?—It might have been there.

Did it purport to have been signed by you?—It did. The same report purporting to be signed by me appeared in several papers.

Was it signed by you?—No. I really do not know how it got into the papers with my signature. I was astonished, on returning to London, to find this article in the newspapers.

How did they get hold of it?—I suppose from the Harness establishment. Part of the article certainly consisted of passages from my report, interlineated by Harness. But for Harness's interlineations, I do not hold myself responsible at all. My position on the *Standard* became uncomfortable, and as I did not like driving an engine with hot bearings, I thought it right to resign. I was off the paper for three months.

Re-examined by Mr. AVORY: His original report was handed to the Medical Battery Company, and became their property; but he engaged that no report was to be published until it had finally received his sanction. His report in full had been suppressed, and never published anywhere.

Had you not given evidence in Court in February, 1893, in the case of Dr. Tibbit's action?—Yes.

And you were examined on the report you had given to the Medical Battery Company?—Yes.

So that the whole substance of your report had been published in 1893?—It was only in the counsel's brief. My report was not signed. I was aware my report had been printed before July, 1893, but I have never given authority for it to be published.

M. LOUIS LOREAU, recalled, said he remembered Mr. Harness being taken ill with paralysis of the legs, and witness attended him in conjunction with a doctor at Potter's Bar. He was treated by statical electricity, and perfectly cured, but witness could not say that it was the electrical treatment alone which cured him. He also remembered Mrs. Harness being ill with hemorrhage of the brain just before her confinement. She was considered as dead by the English doctors, but Dr. Vigouroux was sent for and Mrs. Harness eventually recovered.

Cross-examined by Mr. TERRELL: Will a plate of copper and a plate of zinc placed in an electrolyte, and not in metallic connection, produce an electric current?—Yes.

Assuming you have got a solution of salt, and the plates, how would you measure the current?—He would, in a Daniel cell, measure the current by putting the zinc and copper in connection.

Without introducing a metallic connection, how can you measure the electric current?—The presence of the current can be ascertained by means of a special apparatus. Even when only one metal is used, physiological results are produced in the body. I have experimented with one of the unconnected belts

How did you arrive at the conclusion that that belt produced a current of electricity of 1 volt?—One zinc and one copper gives 1 volt on the galvanometer.

But without connection with the galvanometer?—It is absolutely certain that one of those metals will produce a result upon the body in cases such as hysteria, and I rely upon the experiments made by other doctors.

Now look at this—your report. What part is in your handwriting, and what in the handwriting of Dr. Vigouroux?—Dr. Vigouroux wrote about the doctrine of weak currents. I could not say whether he said a word about Harness's belts. Dr. Vigouroux wrote an elementary treatise, and it was published as a pamphlet with his name. I afterwards asked Harness to withdraw Dr. Vigouroux's name, as he had given no authority for it to be used in the way it was. Dr. Vigouroux requested me to withdraw his name, and the pamphlet was withdrawn in 1890. When Dr. Vigouroux was informed by a correspondent in London that the pamphlet was again published in 1892, he was angry.

Mr. JOEL, electrical engineer, and head of the firm of Joel & Co., said he could not speak of electro-therapeutics, but only as an electrician of 25 years' experience. Mr. Harness asked him to test the belts as to their properties of generating electricity. After considerable hesitation witness consented, and took six months in investigating and experimenting from belts out of the stock. He had written his report. The statical machines in Oxford Street were exceptionally fine machines. Witness tried every kind of electric belt. He found it very difficult to test when worn by another person, so he wore them himself. He was extremely doubtful at first about them. He found every one of the connected belts generated electricity. He measured the electricity. During the prosecution at Marlborough Street witness tested the unconnected belts and found they also generated electricity. He had a wooden mould made, of the size of a man's waist, covered it with felt, and then with a strip of chamois leather. Then with iodide of potassium and starch solution he put an unconnected belt on this, and left it for 12 hours. On taking off the unconnected belt he found by the decomposition and discolourations that there had been a current. With regard to the currents in the human body irrespective of a Harness belt, witness had during his testing experiments, measured the currents at various parts of his own body. He found that the current from the stomach measured $\frac{7}{10}$ths of a volt. Other parts of the body from the hand to the stomach gave very much less. The quantity was extremely small, but still measurable. He measured the currents by placing a piece of metal on his body, tongue, or hand, and connected the metal with a galvanometer. He had also measured the current from a Harness belt worn on the body. With an unconnected belt when worn on the body, the moist webbing formed a conductor or connection. The effect of the statical chair witness had found in his own case to be tonic and beneficial.

Cross-examined: You were once a member of the Institute of Civil Engineers?—I was.

You are not now?—Well, yes, I am now.

You are now?—Yes.

Why do you hesitate?—Because I have never used my title as a member of the Institute of Civil Engineer in any of these pamphlets—I did not think it right to do so—I simply described myself as an electrician.

You would not describe yourself as a member of the Institute of Civil Engineers?—I would not in connection with this work.

You were once a member of the Institute of Electrical Engineers?—I was.

You are not now?—I may explain I was one of the first six members of the Institution of Electrical Engineers, but when Mr. Sabine, who was my employer at that time, gave it up—he was also one of the first six—he disagreed with their practice and I also disagreed with their practice, and we simply resigned. He knew that if a plate of metal was placed on one part of the body that was hot, and a plate of the same metal placed on another part of the body that was cold, there would be a slight electric current. He knew that scientific men of eminence had used search points of Sir William Thomson's galvanometer for the purpose of testing the passage of currents or leakage. The current produced by a connected belt was 2 milliampères; no, ·2 milliampères.

Now, supposing you have a surface of human skin moistened with perspiration as much as you please, and you place a plate of copper and a plate of zinc unconnected, would a current pass between the two?—Certainly not. They must have some medium.

In the belt you tried, were there brass eyelets in connection with the zinc discs?—Yes; and those brass eyelets may have got in connection with the saline solutions.

Can you tell me how an electric current produced by a zinc disc with a brass eyelet could travel into the body of the person having it on?—If you have a number of zinc discs with brass eyelets in different parts of the body, it is quite possible that the current would go from the zinc disc in one part to the zinc disc in another part of the body.

Do you suggest that as a scientific answer?—Yes.

Is not each brass eyelet a separate galvanic cell?—No; one zinc disc with brass eyelet with another zinc disc with brass eyelet would form a galvanic cell if they happened to be touching.

Ah, but in this belt of yours. I understand that the brass eyelets were not in contact with each other, were they?—They were not connected. It was an unconnected belt. One disc was copper and the other was zinc.

Is it not a well-known fact that starch and iodide of potassium are in such chemical relation to each other that they are decomposed in thousands of different ways?—I am not aware of that.

Do you not know that the use of starch and iodide of potassium is a common chemical re-agent?—It is one of the electrical tests. My piece of wash-leather was saturated with pure water. The zinc was not pure; it was supplied by Harness. It is difficult to get pure zinc.

Impure zinc would set up a chemical decomposition of its own?—A local action.

You prefer to attribute your results to electrical action than chemical action?—Yes; I am an electrician, not a chemist.

Dr. ARTHUR JOHN HARRIES, practising at 6, Adam Street, Adelphi, Honours Man in Chemistry at London University, and gold medallist at University College in therapeutics, said, before 1892, he did not know Mr. Harness. He was consulted by Mr. Gatehouse, of the ELECTRICAL REVIEW, regarding dosage as commonly used in electro-therapeutic treatment. Subsequently a leader appeared in the ELECTRICAL REVIEW quoting his name. Three days later he was asked by Mr. Harness to make an investigation and report on the belts. He made a report, which was a perfectly honest and *bonâ fide* report, with regard to the connected belts. They produced a current when applied to the body in a state of moisture, but he would not say of what therapeutic value the current was. The belt would produce sores which would not go away very easily.

Cross-examined: Supposing a person wore the belt over their shirt or first garment, he should say it would not have any effect upon the body.

Mr. JOHN C. FELL, member of Institute of Mechanical Engineers, said he did not know Mr. Harness, but had examined one of his belts, and made a report on it in February, 1893. The belt generated electricity.

Mr. CECIL GREENWOOD, surgeon, in general practice at Clapham, said in 1889 he was suffering from ill-health from over work. As an experiment he bought a belt at Oxford Street, and wore it for two or three weeks. He felt better, and attributed the improvement to the belt. He wore that belt at intervals until it was worn out, and then bought another. He generally wore this in wet weather. In consequence of his own experience he had recommended these belts to several of his patients, and they had derived benefit from wearing them. In the belt he wore the discs were connected, but they could be connected or disconnected. At first the belt caused sores on the skin, and he therefore wore it a few days outside his under vest.

Cross-examined: He was already much better when he put the belt outside his vest. He could not say whether it did him as much good worn outside the vest. A common cholera belt giving warmth to the abdomen was often of benefit, and could be bought cheap. During an influenza epidemic he had worn the belt as a tonic, and found all the difference when he wore it and when he did not.

Re-examined: He thought electricity was becoming a recognised remedy for all kinds of diseases.

Mr. PAUL, assistant lecturer on literature at King's College, said in 1892 he was tutor in Mr. Harness's family. It was suggested to him that he should investigate the belts for a fee of 50 guineas. [The witness was stopped by the Judge on the ground that his evidence was not important.]

Dr. RUSSELL HARRIS, surgeon, was asked in 1892 to examine and report upon these belts. He found that a small current was generated by the connected belt.

Cross-examined: He got a fee of 50 guineas for the experiments and reports. These belts, without external connection, were incapable of generating electric currents.

The Rev. Mr. SHAW gave evidence that he had suffered for years from a "clerical throat," and consulted all the best physicians for 25 years, and tried every remedy without success until he tried a Harness belt and an electric battery. He attributed the improvement in his throat to the use of the belt and battery combined.

Mr. EDWARD CHURCHILL, builder's manager, 46 years old, stated that he had suffered for years from lumbago and hemorrhoids. He had consulted many doctors, without permanent benefit or relief. He bought a belt and wore it, and his complaints disappeared, and had not returned.

Major-General PLAYFAIR, retired officer of the Bengal Staff Corps, said in February, 1889, he was in bad health, and went to the Medical Battery Company. He was at that time suffering from general debility. He thought he saw Dr. McCully. He purchased a three-guinea belt and wore it. He felt better after wearing the belt. He subsequently bought a battery and spine band. In 1891 he went to the establishment and underwent a course of treatment by statical electricity. Dr. McCully treated him skilfully, and he thought he was better for the treatment. Subsequently he wrote a testimonial to Harness.

Cross-examined: Dr. McCully never mentioned or recommended the belt.

By the JUDGE: He could not remember what fee he paid for the three months' treatment.

Mr. AUGUSTUS FLEET, solicitor, said at the time the action brought against *Science Siftings* was settled, he acted as solicitor for the Medical Battery Company. Before the cheque for £1,300 was paid to settle the action, there was an arrangement between him and the solicitors for the journal. The cheque was given to witness's clerk with certain instructions. When the clerk came back he made a report. The clerk had no business to pay the cheque without an undertaking on the part of *Science Siftings* to withdraw all imputations. Witness afterwards saw the solicitors for *Science Siftings*, and demanded a notice in the paper that all imputations were withdrawn. The solicitor said his clients were men of honour, and would insert it. Witness could not say whether the notice was ever published.

Cross-examined by Mr. WITT: His clerk only got a verbal undertaking instead of a written one. The cheque was paid on Saturday, and when the clerk came back there was a discussion as to whether an application should be made for an injunction to stop the cheque. It was decided not to apply for an injunction, but to rely on the verbal promise to publish the notice.

Mr. ABINGER next called the defendant.

Dr. JAMES MONTGOMERY MCCULLY said he was M.D. of Dublin, M.R.S.C., England. He took his degree in 1864, and held his diploma from the same year. He had been medical officer of health for a large district in the Midlands, comprising three counties. He had held a commission in the Lancers and Dragoons, and was attached to the staff of the Indian Governor. When he retired from the Army he took an appointment under the Local Government Board at £800. During his medical career he had frequently used electricity. He was struck off the Medical Register in consequence of writing a letter which was held to be a libel. He had taken steps to have his name reinstated. While he was a servant at the Medical Battery Company on a salary, it did not matter to him whether he was on the Medical Register or not, as he had no fees to recover. He was in no way connected with the profits or losses of the company, and never knew anything about the advertisements. He had a consulting room upstairs where he treated his patients, some of the first ladies and men in the land. They were placed on an insulated platform and treated by the statical method. No complaints had ever been made to him. Colonel Brasyer's was the only complaint which had come to his knowledge. Colonel Brasyer was brought to his consulting room. Witness found out that he had been in India, and was 82 years of age. Colonel Brasyer suffered from senile decay. Witness told him he was a very old man, and that he could not guarantee that electricity would do him any good. However, he consented to do his best for Colonel Brasyer. He was then placed on the statical machine and treated quietly. After the treatment Colonel Brasyer expressed himself perfectly satisfied, and, out of gratitude, constantly asked witness to lunch with him. It was impossible the Colonel should have received the injury to his shoulder which was alleged in this action. On Saturday, July 2nd, 1892, Colonel Brasyer sent for witness at 10 o'clock at night. The Colonel was suffering from pains in the stomach, and witness attended him. This was nothing to do with the Medical Battery Company. It was subsequent to this that witness found out Colonel Brasyer also suffered from a rupture, and got a specialist to see the plaintiff. The specialist ordered a truss from his own truss maker. The Colonel gave witness a cheque for ten guineas, which was five guineas for the specialist and five guineas for witness. The plaintiff wanted to give witness more, but he said five guineas would be ample for himself. On July 15th he received another telegram from Colonel Brasyer, who was still staying at Cannon Street Hotel. Forrester, the plaintiff's servant, told witness the Colonel had fallen down in the dark, and hurt his arm. Witness procured some liniment and rubbed it in. The plaintiff complained for some time of his arm, but he was able to sign his will after this. Witness paid the Colonel about twenty-one visits at Cannon Street Hotel. His bill included cab fares, and was very moderate. Colonel Brasyer invited him down to Margate for a day, and said he would then pay the bill. At Margate, the plaintiff said the bill was exorbitant, and he must have the items. Witness said the Colonel must pay him the amount he was out of pocket, and he would give him the items later. Colonel Brasyer sent him down a £10 note and witness did

not see the plaintiff again. Colonel Brayser at this last interview insinuated that his arm had been hurt at Oxford Street, and witness told him he must not say that, as the injury was caused by the fall at Cannon Street Hotel. On Tuesday evening, November 7th, 1893, a police constable came to witness's house with a warrant for his arrest. Witness at once took a hansom to the police station, where bail was refused. He was searched, and his money, keys, and knife taken from him. He was put in a cell for the night, and next day removed to Holloway. For fourteen days he was imprisoned. After a few hearings the magistrate reduced the bail to £100. The case was remanded for three months, and witness was involved in £200 law costs.

The hearing was adjourned.

Fourth Day's Proceedings.

Dr. Stanley Boyd, surgeon at the Charing Cross Hospital, and a specialist in the treatment of rupture, said Dr. McCully called him in as second aid in his treatment of Colonel Brayser. If he had known that Dr. McCully's name had been struck off the Medical Register, he would never have consulted with him. It was against the rules to do so. The witness did not remember Colonel Brayser complaining of an injury to his arm and shoulder, nor of his having received any injury at the hands of Dr. McCully.

Dr. McCully was again called into the witness box and cross-examined by Mr. Witt. He admitted that he was tried for libel and convicted at the Central Criminal Court. He was sentenced to two years' imprisonment.

Mr. Justice Charles observed that was the maximum sentence for publishing a libel knowing it to be false.

Mr. Jelf: No; the maximum sentence would include hard labour.

Dr. McCully said he was not sentenced to hard labour. The charge was for writing a libel of a lady teacher of the London School Board. He served his term of imprisonment.

Some letters and post cards written by the witness were read. They contained serious charges of immorality against the lady.

"Were you also indicted," asked Mr. Witt, "for writing and publishing a letter to Mrs. Westlake, a member of the School Board?"—"I wrote a letter containing nothing but the truth," retorted the Witness.

Did Mrs. Westlake give evidence against you?—No; but some lady did. I do not know her name.

Did you at 52, Oxford Street attend ladies?—Certainly.

Young ladies if they came?—There were no young ladies came there. The ladies I had to deal with were married and elderly ladies.

Did Mr. Harness know of this conviction?—I suppose so; it was published in the papers.

Before you went to fulfil this engagement with Harness, had you ever studied electricity?—Yes; the same as other surgeons would.

Did you at Oxford Street devote yourself chiefly to statical electricity?—Chiefly so.

Did Mr. Harness treat people himself by statical electricity?—Very, very seldom, but it was before my time. I believe I could write the names of two ladies who were treated by Mr. Harness while I was there. Those are the only two I know of.

Did you treat people while at Harness's as a general practitioner?—No; certainly not.

Did you treat people there for rupture?—No; there was a man on the premises who saw ruptured patients.

Did you tell Colonel Brasyer that he was too old for electricity to do him any good?—I did, after seeing him for three minutes. I did not know that he just a few minutes before paid 50 guineas for a course of treatment.

Before Colonel Brasyer saw you, he had not seen any medical gentleman at the establishment?—I do not know. I have every reason to think he had.

Now did you either directly or indirectly ever touch any money of Colonel Brasyer's beyond the £10?—Nothing beyond the five guineas fee and the £10. With the exception of a few shillings for sundry things I paid for him, I swear I never touched his money.

When Colonel Brasyer gave you the 10-guinea cheque, he wanted you to have more, and you said it was quite enough?—For that one transaction.

Did you tell Colonel Brasyer that of this cheque Mr. Boyd, the specialist, was to have five guineas, and you the remainder?—I do not think Colonel Brasyer asked about it.

How much did Colonel Brasyer pay Colonel Herbert for writing his memoirs?—100 guineas.

How much of that did you recieve?—What I had arranged with Colonel Herbert when I introduced him.

How much did you get of that 100 guineas?—£20.

Then what did you mean by saying just now that neither directly nor indirectly had you touched Colonel Brasyer's money?—This was not Brasyer's money; it was Colonel Herbert's well earned money.

Did you get any commission from the truss makers?—Not a farthing.

Why did you not have a Harness truss?—I know nothing about Harness's truss. I took Colonel Brasyer to a proper surgeon and took his instructions.

At the time you wrote this letter (produced), were you under remand at the police-court?—Yes: but I protest against your reading a letter marked "Private, confidential," and "without prejudice."

Mr. Justice Charles having seen the letter, held that the learned counsel could read it.

Mr. Witt read the letter dated from Blandford Mansions, December, 1893, to a firm of solicitors, to this effect: "In any further action after the present case is over against Harness, the Medical Battery Company, Limited, or both, be assured both yourself and counsel, that I am and will be your staunch and reliable witness and supporter in every way in my power, against both Harness and the said company." Witness admitted the letter.

"Did you mean by that," asked Mr. Witt, "that you wished to turn Queen's evidence?"—"No," replied the Witness, "I wished to show that I was free from Harness and his directors, and that I was open to tell the opposing counsel everything in my power. I wished to vindicate my own character, and thought I had been treated very badly by being left in prison for a fortnight."

Then you wrote that you wanted to see Messrs. Collyer & Collyer, the plaintiff's solicitors, that you wanted to see them on a totally different matter. What did you mean?—I cannot remember now, but I suppose I mean the claim for damages for my imprisonment. I thought Colonel Brasyer had a bad case and would be sure to come to the wall.

Now, supposing the Wimshurst machine is improperly used, could it injure a man's arm?—To the best of my belief, not even a child's arm. I am not an electrician.

But you were the operator at Harness's, you know?—Yes. I was a qualified doctor when I was twenty.

Colonel A. R. K. Herbert, of the Madras Cavalry, examined by Mr. Abinger, said he knew Colonel Brasyer, and he had known Dr. McCully for many years. Dr. McCully was attached to the same regiment in India. In 1892 Dr. MCully introduced witness to Colonel Brasyer for the purpose of writing his history. Colonel Brasyer agreed to give witness a fee of 100 guineas to compile his memoirs. Colonel Brasyer had never complained in the presence of witness of anything the matter with his arm. On one occasion witness thought Colonel Brasyer had a touch of rheumatism. Colonel Brasyer and witness went to Margate. When Dr. McCully came down to get his account paid, Colonel Brasyer said one or two insulting things about 52, Oxford Street, and Dr. McCully got warm. Colonel Brasyer then said he could not write a cheque because his hand was bad.

Cross-examined by Mr. Witt: After the agreement was made with Colonel Brasyer to compile his memoirs for 100 guineas, witness saw Dr. McCully, who asked for one-third of the fee. Witness promised it. Dr. McCully did not "bully" Colonel Brasyer at Margate.

By Mr. Jelf: Witness had nothing the matter with him, but he got a Harness belt. He did not pay for the belt; it was presented to him. He found it made him sleep better.

Mr. Oliver Stockman, solicitor's clerk, said he was for 11 years in the employment of Mr. Augustus Fleet, solicitor for the Medical Battery Company. Witness paid the cheque of £1,300 to the *Science Siftings* proprietors. He saw Mr. Marks, and said he had instructions to settle the matter, and asked Mr. Marks what amount he would take. Witness suggested Marks should accept the same amount of damages as awarded in the Alabaster and Gatehouse case, and that Harness should pay his costs. Mr. Marks said his costs would come to £500. Witness told Marks he was afraid Mr. Harness would not give that amount, but would go and see Mr. Harness. On a second visit Marks agreed to accept a cheque for £1,300 on condition that Harness would see Dr. Tibbits to withdraw his action against *Science Siftings*. Marks said he would publish that all allegations were withdrawn. Mr. Fleet had supplied witness with a paper which he wanted Mr. Marks to sign. Marks would not sign the receipt with the condition that they should publish a withdrawal in their paper, but said he would publish that the action had been amicably settled.

A discussion ensued between Mr. Jelf and Mr. Justice Charles as to the admissibility of certain evidence. Mr. Jelf said he claimed the right to show that Mr. Marks and Mr. Collyer, the solicitor for the plaintiff, had been pushing the criminal proceedings with the view of squeezing money out of Harness.

Mr. Justice Charles said he should, when the time came, ask the jury whether Colonel Brasyer honestly believed in the case that he laid before the magistrate, and whether in that he was actuated by malice. As to the plaintiff's agents, he should probably direct the jury to find whether they had exercised ordinary care.

The Witness, in further examination, said Mr. Marks told him they had sufficient information to convict Harness, and that Harness would not be able to stand the cross-examination. Marks also said Mr. Harness would probably find himself at the Old Bailey.

Cross-examined by Mr. Witt: He had been a solicitor's clerk 15 years. He was not now in Mr. Fleet's employment; he lost his situation through this wretched matter with *Science Siftings*. Witness believed now that what Mr. Marks said about Harness was for the purpose of intimidating Harness to settle the action then pending against *Science Siftings*. There was certainly a promise to publish a retractation in *Science Siftings* of the charges against Harness, or witness would not have settled the action.

Mr. Thomas Roberts, formerly proprietor of *Illustrated Bits*, deposed to purchasing a belt while he was suffering from nervousness and rheumatism. When this was worn out he bought another. The testimonial he gave Harness was genuine. Cross-examined: Harness advertised in his paper.

Mr. Robert Bagster, publisher, of 15, Paternoster Row, purchased a belt in 1891, and gave a testimonial as to the benefit he derived from it. Cross-examined: He sent the belt back to be "re-charged." He understood it could be re-charged.

Mr. John Marchant, 73 years old, retired colour serjeant of the army, stated that he bought a Harness guinea belt for pains across the back, and was wearing it now. The belt had relieved him, and he could now walk upright or pick up things from the ground. Cross-examined: Did not know whether the belt he wore was a connected or unconnected belt.

Mr. Jelf said he had several other witnesses of this sort, but he would not call them if Mr. Witt would admit the book of testimonials.

Mr. Justice Charles said he thought it sufficient that Harness had received a large number of genuine testimonials. He would take it that a large number—a very large number—of genuine testimonials had been received.

Mr. J. H. Timpson, messenger at Marlborough Police Court, produced the depositions sworn in the proceedings at that court last year.

This concluded the evidence for the defence.

Evidence was then called to meet the defendants' counterclaims for malicious prosecution.

Mr. Collyer, present solicitor to the plaintiff, called by Mr. Witt, said that he was consulted in the matter of the prosecution of Harness by Colonel Brasyer. The actions by Alabaster & Gatehouse and by Dr. Tibbits against the Medical Battery Company and their settlements, were matters within witness's knowledge. He also knew of the action by the Medical Battery Company against Alabaster and others, which the company brought and afterwards settled, and the action by the Battery Company against the proprietors of *Science Siftings*, in which the company paid £1,300. He had read the articles in the *Pall Mall Gazette* and many other papers, and got possession of numerous pamphlets of Harness, besides reading the company's advertisements. He further caused enquiries to be made as to the mode of business at 52, Oxford Street, and, before laying the information before the magistrate, consulted counsel. He put a mass of papers before the counsel prior to taking his opinion. All possible enquiries were made about Harness and the antecedents of Dr. McCully. Witness had had nothing whatever to do with any litigation in which Mr. Harness had been engaged prior to Colonel Brasyer's case.

Cross-examined by Mr. Jelf: He first received instructions from Colonel Brasyer about the Harness affair in September, 1892. It was nine months later before he said a single syllable to the Battery Company about any complaint from Colonel Brasyer. When he wrote to Harness he unfortunately said Colonel Brasyer demanded the money back for his "trusses." That was an error for "belts." The injury to Colonel Brasyer's shoulder was the most serious part of the claim. The truss was supplied under the instructions of Dr. McCully, and Colonel Brasyer considered Dr. McCully part of the Harness Company. He therefore concluded the truss was supplied by the Battery Company. Witness first knew Mr. Marks seven or eight years ago, as a clerk in the office of Mr. Alfred Jonas, a solicitor. He had since been in the office of Mr. Morris, solicitor. Witness did not hear all he knew about the other actions from Marks, but he learned all about the *Science Siftings* action from Marks. Witness did not go to the Battery Company and ask to investigate the books, although it had been advertised that the establishment was open to inspection. Witness considered this invitation was only extended to the medical profession. He did not take the trouble to enquire as to the position and antecedents of the proprietors of *Science Siftings*. He saw the correspondence in the settlement of the action by the Battery Company against *Science Siftings;* the solicitor, Mr. Morris, showed it to him.

Was it a coincidence that you and Mr. Marks both appeared before the magistrate with informations against Mr. Harness?—I knew Messrs. Morris were instructing the same counsel as I was in the matter. I knew Morris & Co. were going to take criminal proceedings for other persons. It was not the fact that I thought taking criminal proceedings would produce the money.

At the time this warrant was issued, did you know that Mr. Harness was living at the same house that he had for years, and was attending every day at Oxford Street?—Yes; but in view of what appeared in the *Pall Mall Gazette*, I thought it probable he might go away. Such articles are not published in the *Pall Mall* every day.

Can you put forward any excuse for putting Mr. Harness to this indignity?—It was for the magistrate to read the information before granting the warrant.

Did you instruct counsel to apply for heavy bail?—I think I can safely say I did not, but I will not swear positively one way or the other.

In further cross-examination, the Witness was closely questioned by Mr. Jelf as to the way in which he worked up the information and conducted the prosecution of Harness and McCully.

Questioned as to whether or not the proceedings against Mr. Harness were carried on with a certain amount of speculation, and that witnesses were put in the box as they happened to come forward, Mr. Collyer said about one-third of the witnesses came forward after the proceedings had commenced. Witness was aware that the appliances at Oxford Street were being sold under an order of the High Court; but as belts only, and not as electric belts, and at greatly reduced prices.

The hearing was further adjourned until Monday.

Fifth Day's Proceedings.

On the resumption of proceedings on Monday,

Mr. Collyer, the plaintiff's solicitor, was further cross-examined. On Friday he said he thought he instructed counsel to apply for a "process" against Harness. On reference to his papers, however, he found he had instructed Mr. Terrell to apply for a warrant. The original intention had been to proceed civilly, but after the articles in the *Pall Mall Gazette* they determined to take criminal steps. In the prosecution at Marlborough Street there were 400 witnesses to call, but at the request of the magistrate the case for the prosecution was closed when only six witnesses had been called, the counsel for the prosecutor thinking the magistrate intended to commit.

Mr. Arnold Jacob Marks, managing clerk to Mr. Morris, solicitor, said he had charge of the action between the Medical Battery Company and *Science Siftings*, and he saw Mr. Fleet and his clerk, Stockman, with reference to settling that action. There was never any agreement to publish a withdrawal of all charges against the Battery Company. It was part of the arrangement that Dr. Tibbits should withdraw his action against the Battery Company.

Cross-examined by Mr. Jelf: He was one of the defendants in the action of Beyfus *v.* Jonas and others, tried some years ago. It was an action for falsely preferring a criminal charge against Beyfus to extort money from him. The jury found a verdict for the witness. With regard to the *Science Siftings* litigation, witness only knew Mr. Woolf as a client of the office he was in. Witness, as representing *Science Siftings*, met Stockman as representing Harness, but not one word was mentioned about publishing a retractation.

Mr. Tom Ernest Gatehouse, called and examined by Mr. Witt, said he was editor of the Electrical Review, and had had twenty years' experience as an electrical engineer. He had been for some years assistant to Sir Charles Wheatstone.

Have you had anything whatever to do with *Science Siftings*?—Neither now nor at any other time.

Have you given great attention to these belts of Mr. Harness?—Yes.

What do you say as to the unconnected belt?—It is quite impossible to produce a current of electricity by an unconnected belt.

With regard to the connected belt. Does that generate a current of electricity?—Yes; very minute.

What do you say as to the force of electricity generated by a connected electric belt?—It depends upon the degree of moisture upon the skin. But in my measurements I have found from $\frac{1}{100}$th to $\frac{1}{10}$th of a milliampère. In one case it was less than one-thousandth of a milliampère. The subject had a very dry skin.

Supposing the person wearing the belt so perspired as to wet the webbing itself. What would be the direction of the current?—The current would pass through the webbing of the belt.

Supposing a less active perspiration that did not saturate the webbing; where would the current pass?—Then the current would pass across the skin. Of course, I am speaking of a connected belt.

What would be the result upon the skin?—It would have the effect of producing sores wherever the zinc discs touched the skin. When a zinc disc comes in contact with perspiration, which is mainly composed of chloride of sodium, and in the presence of air, the oxychloride of zinc forms a poisonous salt, and brings sores on the body.

Supposing the belt were worn over a garment, or under-vest, would it have any electrical effect upon the skin?—No.

In your judgment, does any electrical current pass into the body from these belts?—My experiments all point to the contrary.

Have those experiments been repeated and prolonged?—Yes; from the date of the Jeffery action in the Bloomsbury County Court up to the present time. I gave evidence in that case.

You continued your experiments for the purpose of qualifying yourself for evidence in your own action?—Certainly.

And have continued those experiments since?—Yes, up to this morning.

As a result, you have come to the conclusion that an electrical current does not pass into the body?—My case is, that it does not pass through the body.

Being an electrical engineer, you do not go into the therapeutical side, but deal simply with the electrical effects?—Yes.

Supposing a patient is treated with the Wimshurst machine and statical electricity, can a machine of that kind, if negligently and improperly used, injure a person's limb?—I would rather not express an opinion on that point. I have never experimented with the Wimshurst machine on the human body.

In answer to further questions, the Witness said he had charge for some years of the Testing Department of the British Telegraph Company; he had been consulting engineer to the Cuba Submarine Telegraph Company, and was a member of the Institution of Electrical Engineers.

Have you experimented with the belts given in evidence at the police court and with others?—With a number of belts which all came from Harness.

Cross-examined by Mr. Jelf: You have taken a strong view against these belts for a very long time?—Yes.

And your mind has always been against them, more or less?—I should say rather more than less.

But your judgment has wavered up to this very morning?—Not at all. The experiments were continued up to this morning not on account of my judgment, but for some other purpose.

What other purpose?—For the sake of his Lordship and the jury?

You wanted to see whether certain results would follow certain things?—Not at all.

Apart from trying these belts, what independent knowledge have you had of electricity as applied to medicine?—I have applied a battery to people to see the results, and also induction coils; but, honestly speaking, electricity applied to medicine has not been my line.

Do you say that neither from the connected or the unconnected belts did any current of electricity whatever pass into the human body?—Yes; that was my first view.

Did you change that view?—I think not.

Did you hear the evidence of Lord Kelvin when called as your witness in the Alabaster case?—Yes.

Did you hear him say that in his opinion the current did pass into the body?—That was with regard to a special belt.

But your own scientific witness, Lord Kelvin, gave it as his opinion that from a connected belt the current of electricity did enter the human body?—Yes; but he said he had never experimented upon it.

After that, did you say a current *might* pass from the body, but you did not believe it did?—Yes.

Then after the evidence of Lord Kelvin you thought he might be right?—I stated that his evidence did not influence me in the least. I have gone back to the opinion that no current enters the body. I have not changed my view. I think I have always shown that my mind is pretty well made up on that question.

Do you say that chemical electricity does not penetrate the skin?—It penetrates the sweat ducts, passes along the skin, and out at other sweat ducts.

Are these matters upon which opposite opinions may honestly be held by persons skilled in the subject?—No doubt.

Are there thousands of sweat ducts in a square inch?—I should say there are.

Are these sweat ducts better conductors than the surface of the skin itself?—That would depend upon the moisture of the surface of the skin.

Have you ever been to 52, Oxford Street, to see the electrical appliances there?—No; I have had an invitation.

Did you know of this prosecution of Harness before it came on?—A few days before.

Did you give your services to the prosecution free?—I have not asked for any money.

Do you intend to ask for any?—I cannot tell you. I have lost a great deal of time in the matter.

Re-examined by Mr. Terrell, Witness said that when Lord Kelvin gave it as his opinion that a current from a connected belt did pass into the body, Lord Kelvin was speaking of one experiment made by Dr. Tibbits, which was illustrated by a diagram in Dr. Tibbits's pamphlet, and when he was asked the question about the current passing through the body, the Attorney-General had a belt in his hands, and enquired: "If I put one end in my mouth, and hold the other end in may hand, is there a current through the body?" Lord Kelvin, of course, answered "Yes," because by putting one end in the mouth, the skin resistance was eliminated there.

My friend, Mr. Jelf, has questioned you with regard to the difference of scientific opinion as to the connected belt generating electricity. Can any electrician entertain any doubt as to whether it was capable of generating electricity?—An expert would say at once that an unconnected belt could not send a current of electricity through the body.

You have personally tried a long series of experiments to ascertain what the powers of a connected belt are?—I have. As a result of those experiments, I found that the human body is neither affected physiologically, chemically, or thermally by the action of a Harness belt worn on the body.

Is a frog the most delicate test that can be applied with regard to the action of electricity physiologically?—Yes; the muscles and nerves of frogs are always used as standards of comparison to compare with the muscles and nerves of human beings. The current from a Harness electric belt on the body does not in any way energise the muscles of frog's legs, and the muscles of frog's legs are much more sensitive than the muscles of the human body. I tried these experiments in connection with a thoroughly qualified medical man.

Before the witness left the stand he asked leave to state that neither himself nor the Electrical Review was connected in any way with *Science Siftings*, Messrs. Woolf and Hayman, nor with any of the papers and names so indiscriminately referred to.

Prof. Victor Horsley, F.R.S., F.R.C.S., and Professor of Pathology at University College, was next examined by Mr. Witt.

Do you find in your experience in diseases of the nervous system that the use of something in which the patient believes goes a long way?—Unquestionably.

If the patient can be got to believe that belts are charged with electricity and will have an action upon him, will that belief assist him in cases of nervous disorder?—Oh, yes; certainly.

What do you call that method?—Suggestion.

And the old idea of charms and amulets was the same class of notion?—Yes, probably.

Do you find when patients improve that they are convinced of the virtue of these belts and appliances?—Oh, yes; I have met a great many.

Apart from electricity, do belts give support and warmth to the body?—Yes.

Is there a class of cases in which warmth and support are calculated to do good?—Yes; hysterical cases.

Have you examined any of Harness's belts?—Not scientifically; I have seen them produced by patients who have consulted me. I have paid a great deal of attention to electricity.

Have you formed any opinion upon the operation of the connected belts upon the body in a therapeutical sense?—In a medical sense I think they have no operation upon the body. The resistance of the skin is so high, and the current, even in a connected belt, is so extremely feeble, that it could not penetrate the body.

And the skin action would be of the nature of an irritant?—Yes.

Would it have that effect upon the skin which has been described. Would the perspiration thrown out, the chloride of sodium, produce local sores?—It would produce local sores.

It has been said that the current passes into the body through the perspiration ducts. What do you say?—If a current passes from one point to another, it can only pass through some conducting material, and that can only be by the skin. But there is no penetration of the skin. If it passes at all it must be on the surface. It never gets through the skin. I have no doubt about that.

Cross-examined by Mr. Avory: Have you personally ever made any experiments for the purpose of ascertaining the course of electricity through these belts?—No.

Did you read Lord Kelvin's evidence that the electricity generated would pass through the body?—No; but if copper and zinc are placed in certain positions a current might pass through a part of the body.

Do you differ from Lord Kelvin on that point?—No, because I have already stated that if the discs are sufficiently close, and the skin sufficiently saturated, there might be a small current pass along the epidermis.

Do you suggest it must pass through the internal organs of the body in order to have any therapeutical effect?—Yes; it must pass through the nerves.

But the nerves are pretty near the skin?—Quite so, but they are all under the skin.

Are there currents of electricity in the human body?—No one has ever yet discovered the existence of such currents without error. A great deal of what was formerly held to be animal currents are now proved to be due to the injuries to the tissues.

The action of electricity, as a whole, is very largely believed in as a therapeutic agent?—Yes. It is agreed that certain currents are useful. Dr. Lewis Jones is an authority, I acknowledge.

Are you aware that he says electricity exists in the human body in three different forms?—I was not aware he had said that.

Re-examined by Mr. Witt: Is there anything in medical science which justifies the supposition that by electricity you can produce effects upon chronic diarrhœa, dyspepsia, or locomotor ataxy?—Nothing at all.

Mr. Witt announced that that would be the plaintiff's case.

Mr. Justice Charles, answering Mr. Jelf, said the questions he should leave to the jury would be these:—1. Whether Harness and McCully, or either and which of them, were guilty of false representation, and was Colonel Brasyer induced by these false representations to part with his money; 2. Whether Harness and McCully, or either of them, was guilty of negligence in treating Colonel Brasyer. If the jury found negligence, then there would be the question of the amount of damages. With regard to the cross actions for malicious prosecution, he should ask the jury whether Colonel Brasyer, in prosecuting Harness and McCully, honestly believed in the case put before the magistrate; whether Colonel Brasyer, or his agents, acted with reasonable care in investigating the facts; whether Colonel Brasyer was actuated by malice; and what damages, if any, Harness and McCully were entitled to.

Mr. Jelf, in addressing the jury for the defendant Harness, asked the jury to dismiss altogether the charge of any damage or injury to Colonel Brasyer's arm. The verdict of the jury in this action was a question of social life and death to Mr. Harness. The jury could not on the evidence send him forth a blasted and a ruined man, but would by their verdict restore him to his accustomed place in society. The learned counsel, in commenting on the evidence, characterised the first letter written by the plaintiff's solicitor as nothing but a blackmailing letter. It asked Mr. Harness not only to pay Colonel Brasyer's claim, but also any others the solicitors could come across. They reminded Mr. Harness that he had been unfortunate in a previous action, and they thought he would not come into Court with this action. With regard to Colonel Brasyer, his evidence was not to be relied upon. The plaintiff stated that the defendants "tried to make out he was suffering from rupture," when the fact was that Colonel Brasyer had been ruptured for 20 years, and knew it. Mr. Jelf proceeded to say he did not desire to say anything unfair against the *Pall Mall Gazette*, but he did protest most solemnly against this class of journalism being introduced for the purpose of crying down a man whose case had never been tried. He submitted to the jury that this was not the proper voice of outraged public morality. It did not carry with it the voice of the national conscience. These attacks in the *Pall Mall Gazette*, couched in such fearful language, were anything but creditable to journalism. To hunt down a man who had already been subjected to abuse, and to call him a "blood-sucking scoundrel," was not the way to deal with these matters. The whole of the depositions of Colonel Brasyer proved that he did not know much about the matter, except that he was angry, and chiefly with Dr. McCully. He swore that they were all swindlers and guilty, but did not say of what they were guilty. Colonel Brasyer had said that although he was the prosecutor in the criminal proceedings, he left the case to his solicitor. The Colonel had no earthly right to take these criminal proceedings with the state of knowledge he had. He did not know what injury had been done him, but he was angry, and he meant to make somebody smart for it. There was no earthly reason why the cruelty of arresting Mr. Harness on a warrant should have been practised. Mr. Harness had been ruined and hounded from pillar to post by people who had been actuated by vindictiveness and malice. He had been put to very great expense in defending himself against these various proceedings, and was entitled to substantial compensation at the hands of the jury. There was the solicitor's costs in the police-court proceedings, £1,200, and the loss to Mr. Harness of his position, for which he was drawing a salary of £2,000 a year. The company in which Mr. Harness had put his whole fortune had also been ruined. Apart from the loss of salary and the loss of his position, Mr. Harness was entitled to damages for the ignominy and discomfort he had suffered. This compensation could only be adequately measured by a very substantial sum. The learned counsel concluded by appealing to the jury to do Mr. Harness justice, and said he asked no more.

Mr. Abinger, on behalf of Dr. McCully, said his client had been singled out from six different doctors, all of whom had very high diplomas and degrees. All these gentlemen were employed at this Medical Battery Company. If this company was the gigantic swindle the plaintiff's counsel wished people to believe, it was incredible that Mr. Harness should have risked instant exposure of his company by employing these six highly qualified medical men on the premises. Dr. McCully had been singled out for the purposes of this action because he had suffered imprisonment for libel, and his name removed from the Medical Register. These matters had been introduced into this action for the purpose of prejudicing the defendant's case. But because his name had been removed from the register, Dr. McCully was not the less a qualified man, and entitled to practice his profession. Dr. McCully was merely a salaried servant, giving his services to the company for £320 a year, along with five other doctors and about 130 less important employés. There was not a ray of evidence to convict Dr. McCully of any of the charges made against him, and there ought to be, and must be, a verdict for Dr. McCully. Colonel Brasyer attended at the Medical Battery Company fourteen times after the occasion when he alleged he received the injury to his arm, and afterwards called in Dr. McCully as a friend to treat him privately.

At this stage the trial was adjourned to Tuesday morning.

The learned Judge, in summing up, said that there were two actions to be decided—(1) by Brasyer against Harness and McCully for false pretences and negligence; (2) by Harness and McCully against Brasyer for malicious prosecution. The plaintiff said that both defendants were parties to the issue of false and misleading advertisements, by which the plaintiff was led to present himself at 52, Oxford Street. McCully was not by name a party to the issue of these advertisements, and he was a servant in the service of the company. Whether he was so implicated in the fraud, if fraud there was, as to be liable, was a question for the jury. Did the defendants represent that they were highly skilled in the treatment of the complaint from which the plaintiff was suffering? His Lordship read various extracts from pamphlets of the company which had been put in, and said it was clear that Harness had described himself as a "consulting medical electrician." It was no exaggeration to say that he had no medical knowledge; he had studied in no medical school, and under no doctor; he was in no sense a scientist. What was what he might call the "note of quackery?" Was it a profession that a single remedy would cure everything? His Lordship read a list of the ailments (including premature old age) said to be cured by the electrical treatment. Could any human being in his senses suppose that all those evils could yield to one thing? After explaining the law as to malicious prosecution, the learned Judge left the following questions to the jury:—As to the claim—(1) Were Harness and McCully, or was either, and which of them, guilty of misrepresentations, and was Brasyer in consequence induced to part with his money? (2) Were both or either guilty of negligence in the treatment? As to the counterclaim—(1) Did Brasyer in the prosecution honestly believe in the case laid before the magistrates—(i.) as regards Harness; (ii.) as regards McCully? (2) Did Brasyer or his agents act with reasonable care in prosecuting enquiries before they instituted the case—(i.) against Harness; (ii.) against McCully? (3) Was Brasyer actuated by malice—(i.) against Harness; (ii.) against McCully? (4) What damages, if any, have Harness and McCully suffered? Clearly, if any damages were due, they would be substantial in either case.

The jury returned at 5.30. In answer to question (1), as to the claim, they found that McCully had made no misrepresentations; as to Harness they could not agree. In answer to (2) they found that neither Harness nor McCully had been negligent. With regard to the counterclaim, they could not agree with regard to any of the questions, or either of the defendants.

Judgment was given for Dr. McCully on the claim accordingly.

THE OTTAWA CONFERENCE.

The Inter-Colonial Conference recently held at Ottawa was formally closed last Monday. The importance of such a meeting, the first of its kind, needs no illustration from us. That the British Colonies should, of their own initiative, hold council together on matters which are of pressing interest to themselves (as well as to England), and that England should take only a formal share in such a meeting, is a logical sequence of the Colonial Conference held in London in 1887. The resolutions come to by the Colonial representatives in this Conference (which was summoned by Her Majesty's Government) were treated with lukewarm attention in some cases, and with total neglect in others, by the Central Government, to which they were submitted. Under these circumstances it is not surprising that the Colonies should, independently of the English Government, meet together to discuss and formulate the means by which the bonds between themselves may be drawn closer.

The subjects under consideration have been various, but in each case the Colonial delegates seem to have been unanimous in their agreement to carry out the projects under their consideration.

We would, however, only call attention to the resolution which affects the laying of a cable from Canada to Australasia. All the delegates were agreed that such a line was necessary, and a resolution was passed endorsing the project of a Pacific cable free from foreign control, and asking the Imperial Government to cause an accurate survey to be made of the proposed routes. Now a similar resolution was passed in the Conference of 1887, and practically nothing came of it, as may be gathered from the following extract from a blue book recently published by the Canadian Government.

Sir Alexander Campbell, amongst other things, said: "Canada proposed two or three years ago to assist in a survey. The difficulty which the Admiralty urged was, that they had no vessel to spare, and therefore they could not do it. Canada had several vessels of her own, and she found a suitable one, the *Alert*, an excellent ship for the purpose, which she had been using in connection with observations which she had been making for a couple of years, as to the time Hudson's Bay was open every year for navigation.

"She offered the *Alert* for the purposes of the survey, and in that way she seemed to have answered completely the difficulty raised by the Admiralty.

"Canada wrote over to the Admiralty, telling them that she had a suitable vessel; and then they would not do it at all. Then we offered to pay half the expense. Still the Admiralty would not do it, and there the matter stopped."

To this we would add that H.M.S. *Egeria*, while occupied in general surveying work amongst the islands of the South Pacific between the years 1888 and 1890, took a considerable number of deep sea soundings.

In contradistinction to the above, we would point out that when, on March 2nd, 1891, an Act was passed by the United States Government "To enable the President to cause careful soundings to be made between San Francisco and the Hawaiian Islands for the purpose of determining the practicability of the laying of a telegraph cable between those points," the matter was at once taken in hand, and by May 18th, 1892, the U.S. ships *Albatross* and *Thetis* had completed an exhaustive survey between the above points (a distance equal to about one-third the total length of the proposed Pacific cable), the width of the survey belt being about 300 miles. This survey proved that the depth and bottom were both very favourable for the laying of a cable.

The English Government have had the survey for the Pacific cable in hand for seven years, and we are no better informed on this point than we were seven years ago.

CORRESPONDENCE.

Alternate Current Distribution.

I have to quarrel in very decided fashion indeed with your editorial note to my letter on the above in your issue of to-day. The least I can say of it—more in sorrow than in anger—is that it is hasty unfortunate comment in every line. In the first place, your opening sentence, "The method described in the patent is equivalent to the system of running a third main, or making two circuits, one of which can be completely cut off during hours of light load" does *not* describe my system at all. I should be looking for a lodging in Colney Hatch if it did. In the second place, in failing "to see any advantages in reversing one side of the three-wire mains," you fail to catch the very essence of the invention, the inspiration of the method, the distinctive feature that makes it a possible and useful system; the only way in which the end in view can be attained by an arrangement of mains and transformers alone exclusive of mechanism. Why not cut off the one side of the three-wire system, indeed! and cut off, I suppose, the supply from one-half your customers, or rather cut it down to a fraction of its proper voltage, and even that without demagnetising the transformers in the way desired?

I can't see that *that* would be a desirable or practicable system. The fact is you have momentarily lost sight of the circumstance that both primary and secondary circuits have to be considered in this connection. You must have some means by which you relieve the secondary coil of the transformer you wish to cut out of electromotive force, at the same time you relieve the primary coil, otherwise the effort is vain, as the magnetising energy will simply be taken from the secondary circuit in place of from the primary. My system of doing so is to arrange the mains and transformers so that a reversal on the one side of the three-wire primary mains effects a corresponding reversal on one side of the secondary three-wire mains. And it cannot be done in any other way except by cutting off supply from the secondary circuit, or by severing the connection of secondary coil with the main. This latter necessitates an automatic switch governing the secondary connection of the transformer.

Such plans have been suggested, and I suppose it is to these you refer in your last remark (but I do not know any instance of them having been put in practice as you say). Mr. W. Geipel, of the Brush Company, has a patent No. 3,666, 1893, for a system of transformers fed by separate primary circuits and feeding into a common network of low pressure mains: arranged with automatic switches on the secondary side actuated by the switching on or off of current

to the primary circuits. Mr. Swinburne has, I believe, a prior patent for a similar arrangement. The distinction between these and what I may call the complete automatic systems, is that an extra primary main is used in place of an automatic switch on the primary side as well as on secondary. My method goes yet a step further and dispenses with *all* automatic mechanism, while using only the same number of mains.

The above explanation will show that I can afford to dismiss very lightly the inference you suggest in your last remark that my system is not new though it is most injurious, and I must say you should have been less positive in making it upon the scant consideration that is evidently all you have accorded my specification. It is the first time the suggestion has been made, though I have submitted the system to criticism in some very eminent quarters where anticipations would surely be known if there were any. However, you make of it of course only a bogey of your own imagining, and not of my system, which must stand free of the imputation.

Your remark that the saving effected could not approach that possible with attendance, begs the question whether such large sub-stations will be often possible. But even if they were, your conclusion may be seriously questioned. For one thing, much depends upon the personal equation of the attendant—an equation of high degree, infinite terms, and altogether indeterminate: one, indeed, at least more formidable in appearance than the personal equation of an automatic mechanism, which is saying a great deal. Again, I estimate that the use of one attendant for less than 250 kilowatts of transformer plant would put the balance on the wrong side, be he ever so good an attendant and very poorly paid. Then there is the extra maintenance charge on switches and instruments and the extra rent on capital charge on the larger transformer chamber necessary.

It is clear, in fact, that heavy items on the Dr. side of the account make the method impossible for all but the most exceptional cases, or where the sub-station centres can be made to serve (and are really necessary for) other useful purposes than the one in question—regulation, for instance.

Even for these exceptionable cases, my method will hold its own. For large sub-stations I should use the method of phase differences described in my specification; by which the effective transformer capacity is varied from a certain minimum to the maximum through all values between, by supplying the two sides of the three-wire system with currents which can be varied in phase relatively to each other from consonance through all values to oppositeness. The effective transformer capacity is thus brought completely under the control of the engineers at central station, who can alter it to any value desired by a suitable alteration of the phase difference between the two primary currents. The transformers, not requiring to be divided up into many units, may be large and efficient. To save your space I must pass over the other details; the advantages of the system must be obvious. If further explanation is necessary, I will furnish it with pleasure.

But I should note here that the control of the effective transformer capacity and, therefore, of the transformer losses, is secured by varying the induction in some of the transformers. This is done by the E.M.F. across the outer mains being varied by the change of phase difference between the E.M.Fs. on the two sides of the three-wire systems; the latter E.M.Fs. remaining constant. There is a peculiar advantage in this method of varying the transformer induction in that, besides having a full range, it does not decrease the iron losses at the expense of increased copper loss as happens when the change of induction is made by means of sectional coils and switches.

J. Whitcher.

July 7th, 1894.

[Mr. Whitcher's specification was all we had to form an opinion on. The above letter makes it a little clearer, but we would be pleased to have a short description showing clearly the action of the scheme. So far as it can be gathered from the specification and the above letter, the essence of the invention is not very easily perceived. We don't doubt its novelty in the least, but think it can be much more clearly explained.—Eds. Elec. Rev.]

Electrical Distribution by Alternating Currents.

If Mr. J. Whitcher's letter in your last issue may be taken as a gauge of the opinions formed by your readers of the Lowrie compound intraposed system, after a perusal of your leader of 29th ult., I much fear they have received a wrong impression. A reference to the blue books, Nos. 3,666 and 22,131, of 1893, will show them that the system goes much farther than the saving of magnetising currents—important as this would be—as it will enable work to be done automatically and without expense, which no attendant could do as instantaneously or efficiently. The merits which may, with all modesty, be claimed for Lowrie's compound intraposed system are economy, reliability, and an absolute safeguard to all parts of a distributing system, composed of a number of generators, transformers and mains working in parallel. I would be glad to hear from any of your readers of any similar system which has been either recorded or tried, much less abandoned. Meanwhile I would ask them to suspend their judgment until an opportunity has been given of showing them a practical demonstration of the system.

Alfred Thompson.

July 10th, 1894.

New System of Ship Wiring.

With reference to your description in this week's Electrical Review of a "new" system of ship-wiring as carried out on the *Marguerite*, we would beg to say that we commenced to wire ships on this plan in 1888, and have used it on 53 vessels.

Siemens Brothers & Co., Limited,
Alfred Sabine, *Secretary.*

July 7th, 1894.

We are rather surprised to find the system of wiring used upon the ss. *La Marguerite*, described in your current number as a novelty, and we are still more surprised that the system has not been generally adopted long ago. We have ourselves used this method exclusively both for ship and house lighting for the last six years, and can show you some private houses and a large hotel in Kensington, which we have just completed in which there are no made joints whatever. We quite agree that the cost is not much increased by the extra length of mains and branches, though in some cases it will amount to a little more than the 10 per cent. you name, but this is pretty well covered by the saving on jointing which, if done as it should be would cost as much. Great care must, however, be taken to avoid low insulation of the distributing boards used. We have these made in large numbers, six and nine way, and we are sending one as a sample.

Nicholson & Tyler.

July 6th, 1894.

With reference to your article in last issue, "New System of Ship Wiring," I beg to state that said system is precious old, having been advocated and successfully used by leading electrical firms and steamship companies for many years.

This system, which, by the way, is the only reliable one for steamship installations, has not been originated by Mr. Mackie, as you seem to believe.

Leon H. Cline.

Under this heading you describe in the Electrical Review of July 6th, at pages 5 and 6, what has been well known and carried out for years by the best firms. In my specifications for ship lighting I always state under the heading "Wiring." "The ship will have to be wired on the multiple-main, multiple-branch, double-wire system, thus avoiding joints and danger to compasses" (unless the single-wire system should be definitely preferred by the owners). Who was the first to introduce this excellent "multiple system" of running cables and leads I cannot say, but I am certain that it is too late for Mr. Mackie to claim it as "his system," however well he may have carried it out on the ss. *La Marguerite*, which recently left the Clyde to run the Gravesend-English Channel trip.

I have just looked over my paper on "Electric Lighting

for Steamships," read before the Institution of Civil Engineers on November 11th, 1884, and although there was then a good deal of discussion on "single *versus* double" wiring, I can find no mention of the multiple-main (or multiple branch) system, which is now so much appreciated and applied on account of its simplicity and the total absence for the necessity of joints.

Andrew Jamieson,
The Glasgow and West of Scotland Technical College Electrical Engineering Laboratory.

Glasgow, *July 7th*, 1894.

Under this heading, in your issue of July 6th, I observe that the whole credit of inventing the system of jointless wiring, as described, is awarded to Mr. Mackie. This system I, in common with other engineers, have always employed for several years, and always advocate its use for all installations, whether for private houses, shops, public buildings, or ships.

In the case of damp situations I have found it advisable to place a sheet of stout rubber at the backs of the distribution boards, and having pierced the same with small holes, drawn the leads through, having previously cleaned off all braiding and felt. The sheet of rubber is then secured to the leads by a small loop fastened round each, and the slate, or, preferably, porcelain, board is secured in position and properly connected, after which the containing box with glass door is securely fixed all over, care being taken that the sheet of rubber projects about $\frac{1}{32}$-inch beyond the edge of the box. In ship wiring it is preferable to use an iron containing box having a thick glass front with a rubber seating secured to same with thumb-screws.

It will be found that under these conditions an absolute water-tight and damp-proof arrangement is secured, and, at the same time, the insulation resistance to earth of the whole installation is kept very high. I quite agree as to the cost of this system being in no way prohibitive, but I think your estimate of 10 per cent. on the cost of cable, less the saving in cost of labour, rather low, my experience placing the cost of this system at about 15 per cent. higher than the old "tree" principle.

Another advantage arising from the use of this method for house installations is that as every light, or group of lights, has its own double-pole fuse, the main fuse may be safely fixed to fuse at 25 per cent. above the maximum current passing through the house mains when all the lights are in use; whereas in the usual practice of jointing and single-pole fuses it is calculated for an average maximum current, and this very often causes much inconvenience by fusing on an occasion when the whole of the lights may be particularly required.

Adrian Collins.

July 10th, 1894.

Under the above heading in your last week's issue we were surprised to see a system of ship wiring described as being (1) new, (2) an advance on all previous systems, (3) originated by Mr. Mackie when fitting out the new Thames boat *La Marguerite*.

As regards statement No. 2, we quite agree with you that it is a most distinct advance on the ordinary systems of wiring mercantile boats. We would, however, inform you that we have for the last three years made all the switchboards and a great quantity of the other gear, such as section boxes and distributing boxes, for the Admiralty for a system precisely the same, and perhaps superior to that used on *La Marguerite*.

For your readers' information we may say that the Admiralty use a water-tight system throughout, all cables and wires being lead covered, and all the above-mentioned section and distributing boxes and single light switches being also water-tight. The cables are sometimes led into the boxes through glands, and at other times the lead covering is soldered to a nipple which screws against its fitting with a red lead joint.

Each switchboard, as a rule, controls six or more circuits. Each circuit goes to a section box, and from this box are taken six or eight pairs of leads, each pair going to a distributing box, which boxes each control eight lamps. You will see, therefore, that one circuit from the switchboard, as a rule, takes 64 lamps. These lamps are each on a separate water-tight switch, but at the same time the whole eight can be switched off in the distributing box by an internal main switch working through a gland.

We find that this system uses an enormous quantity of cable compared with the single or double wire system, but we think it well worth the extra money required. The heavy metal section and distributing boxes also very materially increase the cost of fitting a ship out, but the system appears to meet the requirements of the Admiralty.

Ronald A. Scott, Limited.

London, *July 10th*, 1894.

Amicus.—We have received a letter from one, "Amicus," on this subject, but, as the name of the writer is not given, we regret we cannot publish it.

Electricity and Gravitation.

There are very strong reasons for believing that the matter, "ether," through which waves are transmitted, about which we are hearing so much, obeys the ordinary laws of gravitation, that it attracts itself, and being so extraordinarily free to move, is attracted by other matter enormously, whether it be in the form of worlds or atoms. Chemists to-day of the latest school make no hesitation about accepting the laws of universal gravitation to explain all the phenomena of chemistry, and sooner or later electricity will come under the same category, *i.e.*, the genus, matter, and be accepted as an element for present convenience in our ignorance. If we accept the notion that electricity attracts itself, and obeys the ordinary laws of gravitation with regard to itself and to other forms of matter in a more condensed form, then it is not difficult to understand its whole phenomena of disturbance. But when we come to believe that it does obey the laws of gravitation, we shall be led to consider whether it is not time to abandon the notion that between terrestrial bodies the sea of ether (which will have to alter its name probably, or the chemists theirs) is of equal density as we know in the case of other forms of matter; as our atmosphere it is not so, and as we ascend we get electric potential, so that we require ether barometers as well as gas barometers.

Then we shall be led to consider further, and to calculate and trace out where this sea of ether is at zero in potential between terrestrial and other bodies, and we shall no doubt in the former case find lines corresponding to planetary orbits, subject to variation and disturbance from movements of matter, as in sun-spots.

J. C. R.

July 8th, 1894.

Variation of Electric Pressure.

In reply to your correspondent, "M. S.," I may say that the station records show no variation approaching those tabulated by Mr. Chew. The occurence was an altogether local one, and naturally chosen as an example to lay before the Gas Institute.

John Hesketh,
Boro' Electrical Engineer, Blackpool.

July 6th, 1894.

"The Living Wage."

There is a young man about who is evidently in search of the above, but whether or not in as honest a fashion as Mr. Sydney F. Walker advocates remains to be seen.

He professes to come from a distant part of the globe—in my case it was New Zealand, and in another case that I have heard of it was the West Indies—and, with his father, who, by the way, "arranges" all the bank bills in payment of stores ordered, professedly has authority for placing large contracts.

His ostensible business with me was the supply of telephones and telephonic material for a railway, and at the first visit (which was *before* lunch time) after some preliminaries and some requests by me for further detail, he stated that he was a stranger in London, that he had come up from South-

ampton that morning, and would be glad if I could recommend a place to lunch at. Farringdon Road being not the most appetising neighbourhood for business of that kind, I referred him to where I thought he might get satisfaction, for which he was grateful.

The following day he brought a tracing of what was supposed to be the railway system, and *again a little before lunch time.*

I was unable to go into figures then, having another appointment, and I fixed 3 p.m. as the time that they would be ready. Manifestly disappointed he wished for figures at once, in order to cable to New Zealand, but upon my pointing out that our "to-night" was their "to-morrow" and sundry other assurances that I could not give him the figures before that hour, he left.

At 3 p.m. the young man returned, and so to business. The figures of cost came to £3,700, but the young man naively remarked that he was authorised to go to £4,000—and that therefore the order could be taken. In the present state of electrical business—and Mr. Walker will agree—this was downright refreshing, but further particulars were necessary.

The young man had no formal order, had no letter of authority, had no nothing in fact except to deal in figures to the extent of £4,000, with a contempt born of familiarity.

I therefore dictated a letter which he signed both for himself and the railway company. His reference was Messrs. Glyn, Mills, Currie & Co., and finally the young man wrote out, in my presence, a cablegram to New Zealand advising them of the contract made.

In making his adieu (and he was loth to tear himself away), he casually—and only casually—remarked that he had given notice to the Police of his having lost his pocket-book containing all his possessions, and would I mind, as he was returning to Southampton that night, sending next day to enquire if it had been found?

This set the seal upon my suspicions, and it is needless to say that enquiries at Glyn's and at some colonial banks failed to produce anything satisfactory either of him or his railway.

The South Western Hotel, Southampton, neither own the young man nor his father, and the pocket-book—although it is true that notice was given to the Police with full detail—has not yet been found.

The puzzle therefore is "Find the young man's real object." It is certain that he could neither obtain the stores nor the shipping documents without payment. If he wanted his lunch—though he looked uncommonly well-fed—he went a long way round to get it, and his appetite must have been set pretty sharp by the time all his manœuvres were carried out.

Is it that electrical firms in search of "The Living Wage" stand lunches and dinners to four thousand pounders?

Anyway, as the young man was anxious in his enquiries for good electric lighting firms, this letter may cause them to restrain their joy at meeting him, and confine their satisfaction to the watering of their mouth.

The young man's hair is known in railway parlance as "danger," and is evidently in search of the companion light; the young man's name, or rather that he gave me, is Harold Stannard; and the young man's railway is the "Napier and Wellington," *just being built* as he said.

W. J. M. Menzies, *General Manager,*
The Consolidated Telephone Construction Company, Limited.

THE NATIONAL BOILER INSURANCE COMPANY.

We are favoured with the annual report of this company for the year 1893, and must congratulate them upon the fact that only one explosion of a boiler covered by them occurred during the year. This was a boiler of water tube type, but it is only fair to say that the insurance company had warned the owners of the importance of cleaning the boiler more thoroughly.

When the number of explosions of boilers in this country is considered, and the fewness noted, it will be accepted that existing legislation is ample, with the efforts of the voluntary inspection associations, to secure safety. We quite agree with the National Company in deprecating State control of steam boilers—a control that would very seriously hamper steam users in their business and result in heavy losses. Officialdom is far too apt to ride the high horse and there would be great friction. At the same time, we are glad to see that the enquiries into explosions have resulted in a number of orders of costs against owners and others who have wilfully neglected to take proper precautions.

In one case, a Lancashire boiler exploded owing to corrosion of the shell until it was only $\frac{1}{16}$th inch thick. During the year only 27 real explosions occurred in the United Kingdom, and of these, 11 were of that most dangerous of boilers, the vertical; 2 explosions of Lancashire boilers occurred, 2 Cornish, 2 locomotive, 1 portable, 5 externally fired cylindrical, 1 water tube, 3 miscellaneous. Of the total, no fewer than 16 arose from defective condition, as corrosion, &c., and 8 arose from deficiency in care, as overpressure, shortness of water, &c.

Illustrations of some of the defects found by inspection reveal the dangers of dampness in the seatings and surroundings of boilers, a fault usually due to position and frequently avoidable.

The placing of boilers in cellars, with their foundations in what may be termed direct capillary connection with damp earth, is a frequent cause of corrosion. Where absolutely necessary to put a boiler down to the damp level, it is easy to cut off the dampness, and this would be done were not architects too frequently allowed to design and arrange the conditions, engineers only coming in at the finish to find the steam boiler stowed away in some sub-basement below drain level, so that when blown out, it has to be blown out under steam to get the water to the drain level, and so cramped in all its surroundings that it suffers from a bad draught all its life, and is a continual source of trouble and expense.

All the experience of the Boiler Insurance Companies goes to prove that no boiler explodes from any mysterious cause. Mystery is often called in to explain what it is perfectly obvious has been caused by neglect or culpable parsimony, and we once met a man who had resigned a place as fireman at a works where an explosion occurred very soon after.

The explosion was explained by the owner after a manner, but our informant had left his situation because he would not risk his life where danger was wilfully courted by the owner; and our experience is that owners too frequently do neglect even the plainest warnings of the inspection companies. During the last 10 or 15 years, in spite of higher pressures, the number of explosions of boilers has grown steadily less in number, though there are probably many more boilers in use. The raising of pressures has thus not been a cause of more danger, the mechanical construction and the quality of material having increased in goodness faster than steam pressures have grown; and we are, also, now reaping the effects of long years of experience in boiler inspection, it being now 40 years since Fairbairn first initiated inspection as a safeguard. His idea has proved well conceived, and it appears probable that the near future will show still further improvement.

A POINT IN THE ELECTROLYSIS OF ALKALINE CHLORIDES.

The electromotive force requisite for the decomposition of sodium chloride in aqueous solutions has recently been calculated by Nourisson as follows:—

Heat absorbed:—

	Calories.	
$NaCl = Na + Cl$	− 964	
$H_2O = H_2 + O$	− 684	
		− 1,648

Heat evolved:—

	Calories.	
$Na + O + H + H_2O$	+ 1,118	
Formation of compounds of chlorine and oxygen, say	+ 60	
		+ 1,178
Net heat absorption ...		− 470

470 calories represent $\frac{470}{232} = 2{\cdot}02$ volts.

These figures, however, according to F. Oettel, in a recent issue of the *Chemiker Zeitung*, are open to correction; and, since Nourisson has been very much quoted throughout the technical press, it seems desirable to give Oettel's rendering and method of obtaining the electromotive force.

The heat disturbance which takes place in decomposing, electrically, solutions of sodium chloride is a secondary result, and is due to the formation of hypochlorous and chloric acids. It does not affect the primary electrolysis, and is, moreover, of negative sign. In any case, Oettel considers that it should not be brought into account. The following figures, according to his view of the matter, more nearly represent the electromotive force requisite for the primary decomposition of the sodium chloride :—

	Gramme calories.
$-$ (Na, Cl, H_2 O)	$-$ 96,510
$-$ (H_2, O)	$-$ 68,360
$+$ (Na, O, H, H_2 O)	$+$ 111,810
Sum	$-$ 53,060

53,060 gramme calories represent $\frac{53,060}{23\,067}$ = 2·30 volts.

Values of 2·25 and 2·28 volts were obtained by Oettel as the actual potential difference subsisting between gas-carbon electrodes whilst electrolysing common salt solution with a porous earthenware diaphragm, using currents varying between 3 and 60 ampères. Practically the same values were found with potassium chloride solutions. The E.M.F. requisite to electrolyse caustic soda solution was found to be only 1·5 volts.

NOTES.

Favourable City Returns.—It is most gratifying to find the City of London electric lighting returns for June quarter showing an increase of £4,401 over those of last year. Our City columns note this fact.

A Costermonger and the Electric Light.—At a recent meeting of the St. Pancras Vestry a member complained that a costermonger, who held auctions on Saturday night in Kentish Town Road, was using electric light. He asked whether a man who paid neither rates nor taxes was entitled to the electric light. Although this looks an absurd point to raise, it seems to involve a nice legal question, for the costermonger buys his light from a tradesmen who, in turn, purchases it from the Vestry.

The Electric Steering Compass.—The *Times* recently gave a notice of an electric steering compass devised by Lieutenant Bersier, of the French Navy; in this notice the idea was treated as a new departure. We may, however, recall to the recollection of our readers that as far back as August, 1881, an apparatus of this description was devised and fitted up on the British India ss. *Quetta*, by Mr. W. Falconer King, of Edinburgh. The apparatus worked perfectly, and the *Quetta* while coming up the English Channel was steered by it on a straight course for 100 miles, during the whole of which time the door of the chart room from which the ship was steered was kept locked, and no one allowed to touch the steering gear. The idea that such a compass precludes the possibility of any error on the part of a living steersman from fatigue or confusion seems absurd, as it is not while steering a straight course that the steersman gets confused; on any other than a straight course the electrical steering apparatus must be altered by hand. We understand that the reason why this invention did not come into general use in English vessels was that it would not pay; some one having to stand by at any rate to keep a look out, and shipowners appeared to be of opinion that the man might as well be steering as looking on. A short description of Mr. Falconer King's invention appeared in *Engineering* of August 5th, 1881.

The Overhead System in South Staffordshire.—The West Bromwich local authorities have been inspecting the overhead system on the South Staffordshire line with a view to permitting extensions of the system.

The Ayr Contracts.—It was stated at the meeting of the Commissioners on Monday night that the Committee have fixed upon the contractors. The accepted tender is said to be about £10,800. The highest tender was £16,996, and the lowest £10,138.

Probable Extensions at Whitehaven.—The Whitehaven Town and Harbour Trustees feel the necessity of making extensions at once, and with this end in view they have applied to the Local Government Board to sanction a further loan of £5,000. The works have cost up to the present £15,494.

Siemens's Offer to Lay a Pacific Cable.—Mr. Alex. Siemens, says Dalziel, has submitted an offer to the Government of the Dominion of Canada for laying a cable under the Pacific Ocean from Victoria, British Columbia, to Sydney, New South Wales. He undertakes to complete the construction within three years. His offer is now being considered.

The St. James's and Pall Mall Electric Light Company.—We have great pleasure in announcing that the electric current sold by the St. James's and Pall Mall Electric Light Company, Limited, during the quarter ending June 24th last amounted to £7,380, as against £5,848 for the corresponding quarter of 1893. We must congratulate the company on the obvious increase of business, and trust that it may continue.

The Taunton Conversion.—The work of modernising the system of the old electric light company, which was purchased by the Corporation, has been practically completed. The alterations have been carried out in accordance with Prof. Fleming's suggestion, and in all respects the station is up-to-date. Transforming sub-stations take the place of the old house transforming system, new boilers have been put in, modern alternators put down, and the units of machinery have been designed with special regard to economical working. The Corporation have expressed their satisfaction with the change.

Killed by Electricity.—A lad named Rogers was killed by an electric shock at the works of the British Insulated Wire Company at Prescot a few days ago.

The following facts have been kindly forwarded by the British Insulated Wire Company :— The youth, who was 19 years of age, was employed in the dynamo room as voltmeter boy and oiler, the station being in charge of a man who was superintending that and other machinery in the factory. The boy was alone in the engine room at the time the accident occurred, and therefore the exact manner in which he met his death will never be known. He was seen alive at 9.20 a.m. in the engine room, and was found dead at 9.30 by one of the assistant electricians. The current running at the time was at a pressure of 2,000 volts alternating, and on examination it was found that a voltmeter wire, which was well inside the frame and attached to one of the armature connections, had been forcibly broken at the soldered joint, and the end thus dragged away showed evident signs of burning. From the nature of the burns on the boy's hands, and from the fact that he had a mark on the back of his neck, we are led to believe that he was leaning against the rail which runs parallel with the driving ropes and stops short close up to the bed of the machine. We think that while leaning against this rope he must either have slipped or have fainted, so dropping between the end of the rail and the machine, his neck coming in contact with the ropes. While in this position he clutched at the armature of the machine, dragging out the voltmeter wire in question and breaking it at the joint, so getting killed. The verdict at the inquest was "Accidental death," and there was no suggestion of any negligence on anybody's part.

The Woodhouse and Rawson Enquiry.—The Woodhouse and Rawson enquiry drags slowly along. It bids fair to eclipse the famous Hansard case in the time occupied at the Court. Meanwhile everybody is waiting for the contest which may ensue between Mr. F. L. Rawson and the Official Receiver, when the former gentleman is called.

Lighting Experiments at Bournemouth.—Mr. Raworth, on behalf of the Brush Company, has obtained permission from the Town Council to light two or three of the existing street lamps with glow lamps, the current being obtained from the transformer station near the Arcade. The experiment is to be inspected by the Winchester Town Council.

The Newcastle Tramway System.—Electricity as a motive power for trams seems to have been clean bowled in the City Council's discussion. We referred to the matter a few weeks ago when the report of the borough engineer was published. The overhead system has been voted dangerous and an eyesore, the accumulator system was too expensive, and the conduit system was considered vastly inferior to the cable system.

The Alleged Failure at Derry.—We find that the alleged failure of the arc lighting at Derry, mentioned in our last issue, was only a trivial affair after all. The lighting is in two sections, each section being provided with two circuits. The lamps are arranged alternately on each circuit, and a failure of one circuit means the extinction of half the lights. This really happened on the occasion of the failure alluded to. One circuit developed a fault, but half the lamps were left burning; even then the lighting was superior to that hitherto provided by the gas lamps, and it is a fact that the gas lamps were not relighted as we had been informed.

The Colouration of the Ions.—We have several times called attention to researches which have been made by Knoblauch, W. Ostwald, and G. Magnanini, who are endeavouring to solve the obscure problem of the colouration of the ions. It will be remembered that Ostwald's hypothesis is, that, in an electrolyte, the dissociated part has a different colour from that of the non-dissociated part. This theory, however, is considered by Magnanini to be not in accordance with observed facts. This opinion is supported by the results of experiments with violuric acid and its salts, which are detailed in the *Gazetta*, xxiv. (2), pp. 48—56. These substances are selected because they have furnished Ostwald with the results upon which he bases his hypothesis. Most of the paper is of a polemical character, and the results given are of such a nature as not to command general interest. To us they are significant, inasmuch as they compel us to regard Ostwald's very plausible theory with some reserve until it is placed upon a firmer basis, and this, we are disposed to think, is not likely to happen.

Power Transmission in Canada.—The Chambly Manufacturing Company, of Montreal, Canada, is inviting tenders for the development of the water-power at the Chambly Rapids of the Richelieu River, the outlet of Lake Champlain, and its conversion into electricity and transmission to the city of Montreal, a distance of about 18 miles. The company has secured control of the entire water-power at the rapids, which have a fall of 62 feet in a distance of four miles. To fully utilise the power, a series of dams would have to be built across the river; but at present the building of one only is contemplated. According to the company's engineers, this would give a head of from 26 to 27 feet, and yield about 27,000 horse-power at low water. Some 15,000 H.P. would probably be delivered in Montreal, of which about 3,000 H.P. would be used for arc lighting, 6,000 H.P. for incandescent lighting, and 6,000 for power purposes. According to the engineers who have been consulted, ice in winter will not interfere with the working of the water-wheels, owing to the dam and peculiar formation of the river. This has been found to be a fatal objection to the utilisation of the power of the Lachine Rapids of the St. Lawrence River, which are located but five or six miles from Montreal.

The Ancient Town of Buckingham.—In spite of the fact that Buckingham possesses both electric and gas works, it is likely that in the coming winter the streets will be lighted by oil. This comes of having gas companies.

Electricity in the Transvaal.—The erection of a large electric power station is contemplated at the famous Rand Mines. A working capital of £250,000 is to be supplied, and Siemens & Halske, it is said, are willing to lay down plant and hand it over as a going concern upon receipt of 250,000 shares in a company with a nominal capital of £300,000.

The Cost of Operating English and American Railroads.—The *Street Railway Review*, of America, in its last issue, compared the cost of working three electric railways. For the purposes of this comparison it took two American railways, the Manhattan, the Intramural, and the Liverpool Overhead Railway. Although our contemporary says that local conditions influence the various items of expenditure, we think it interesting to give the following table as it appears. The sums are cents per train mile:—

	Manhattan.	Intramural.	Liverpool Overhead.
Power-house wages		4·85	1·224
Drivers' wages	8·93	6·36	2·118
Coal or fuel oil	8·92	5·78	1·690
Oil and waste	·25	·95	·272
Repairs	2·41	4·13	·178

Tic Douloureux and Electricity.—The following letter to the *Lancet* has reference to Dr. Hedley's treatment of trigeminal neuralgia reproduced in our last issue:—

Sirs,—The result of the use of the "hydro-electric dipolar bath" in a severe case of trigeminal neuralgia certainly seems to have been magnificent in Dr. Hedley's hands, but the apparatus required for such a treatment is out of reach of most practitioners. It may, therefore, be useful to state that a much longer application of the continuous current, used in the ordinary way by moistened electrodes, than was resorted to in the case alluded to, would probably have had the same effect. To apply the current in cases of severe tic douloureux for five minutes only, as was done by Dr. Hedley, can only be exceptionally useful. For a number of years past I have been in the habit of commencing the treatment in such cases with an application continued for at least 30 minutes, and have occasionally prolonged it for an hour. The result of a single such long application is generally most satisfactory, but the treatment has habitually to be continued daily for two or three weeks before the patient is thoroughly relieved. In order to avoid blistering the skin by such long applications, it is advisable to use a very gentle force, say, 1 milliampère. In one case, in which there was extreme sensitiveness to electricity, I have successfully used a current of 0·60 milliampère only. I generally apply the anode to the painful part, but in one most obstinate case I found it more effective to reverse the direction of the current in the metallic circuit every five minutes.

I am, Sirs, yours faithfully,

Julius Althaus, M.D.

Harley Street, *June 30th*, 1894.

The Litigation between English and French Cable Companies.—The protracted litigation between the Anglo-American Cable Company and the French Cable Company is almost finished. On Tuesday the French Court of Appeal gave judgment. It will be remembered that the French company was started in 1879, and its English rival at once entered upon a war of tariffs, and cut its rates from 3 francs 75 centimes to 60 centimes a word. At the end of 1880 the two companies concluded a convention, under which they worked together for six years. In 1886 eminent legal authorities gave it as their opinion that the agreement between the two concerns was in direct contravention of the terms of the concession. The Minister of Posts and Telegraphs accordingly called upon the French company to cancel the agreement, and the directors intimated to their English colleagues that the arrangement must cease. The plaintiff company sued to recover several millions of francs damages for breach of contract. The Court concluded that the French company had on its own risk and responsibility broken the agreement with the English company, but not being competent, with the evidence in its possession, to decide upon the amount which might be considered reasonable for damages, decided to submit the matter to three experts, who would be appointed to assess the amount due to the English company.

Meter Inspections at Birmingham.—The Corporation are now testing the electric meters of the local company's consumers.

The Bath Electric Lighting Company.—The Bath Electric Lighting Company have given notice of their intention to apply for a provisional order. At the present moment the company is working under a licence.

Burton Gas and Electrical Manager.—We are glad to see that the Burton Corporation appreciate Mr. Ramsden in his dual capacity of gas works' and electrical works' manager. For his special services they agreed at the last meeting to grant him an honorarium of £100, and the payment of an extra £50 a year as manager of the electrical works.

A New Method of "Pickling" Metal Surfaces.—The term "pickling" is used to designate the process of removing oxides and other impurities from the surfaces of metals and alloys by treatment with a suitable liquid, which is usually an acid. A voltaic method appears to do the work much more certainly and with less danger to the surface of the metal in the way of "pitting." The articles to be cleaned are used as the positive pole of a battery, the negative pole being either carbon or wire gauze electroplated with silver, and covered with amorphous platinum black. The bath consists of dilute sulphuric acid, containing a depolariser such as a nitrate or chromic acid. The use of the latter agent completely prevents the evolution of offensive odours. Obviously the current produced during the pickling process might be stored and utilised.

Electricity in the Rhondda.—The newspaper man has been struck with the electric light down in the Rhondda Valley. He retails his experience in the *Cardiff Weekly Mail*, and what his account lacks in technical accuracy is compensated for by fervid description. Still, it is easy to see that the Ocean Collieries there are singularly blessed; they have been partially lighted by electricity for ten years, and now they are fully equipped. In addition, a line from the engine-house conveys electricity to the village of Curnpark, where two chapels, a schoolroom, and some of the houses in the village are lighted by electricity. The newspaper man has been so much impressed, and does such good service in describing the system, that we can forgive him saying that "no comets are used, and each lamp has its own independent switch," nor do we mind the armature which as it revolves "cuts through lines of four."

The Electrolytic Decomposition of Water.—In a paper published in the *Zeitschrift für Physikalische Chemie*, xiii., p. 161—173, M. Le Blanc upholds the view of the primary decomposition of water, and replies to the objections brought forward by S. Arrhenius (*Zeit. Physikal Chem.*, xi., 805—828). These objections were stated in the Electrical Review last November in connection with a paper on the electrolysis of alkali salts, in which we noticed some investigations by Arrhenius. Le Blanc explains the increase in the electrolytic decomposition of water by the addition of an electrolyte, not by an increase in the degree of dissociation of the water, but in the capability of ion formation. He also explains the fact that hydrogen is not immediately liberated during the electrolysis of an alkali salt with a mercury cathode, by stating that the potassium ions, for example, give up their electricity to the mercury more readily than the hydrogen ions do. He considers that the presence of hydrogen ions in the water is amply demonstrated by the fact that potassium reacts readily with water, and not with paraffin. In the case of solutions of various metallic cyanides, Le Blanc points out that cadmium is easily separable, but platinum scarcely so, which is hard to explain on a secondary decomposition hypothesis, unless the electro-deposited platinum were soluble in potassium cyanide. This, however, is not the case. The paper concludes with a comparison of the advantages of the primary decomposition theory with those of the dissociation theory, and points out that from the point of view of simplicity the latter is decidedly wanting.

The Blackpool Extensions.—The Lighting Committee are pushing forward the work of extensions as rapidly as possible.

Scarborough and Leeds Telephone Trunk Line.—The new telephone trunk line between Leeds and Scarborough was opened on Monday.

Coventry Works.—Mr. J. Bruce Crawford, of London, has been appointed Clerk of the Works for the new electric light buildings. There were 106 applicants for the post.

The Crystal Palace Company Extend.—The Crystal Palace Company have given notice of their intention to extend high and low tension mains throughout the district.

Keighley and Electric Lighting.—A Committee of the Corporation have considered the introduction of the electric lighting favourably. They will ask the Corporation to sanction an application for an order.

The Other Side of the Case.—Mr. Hesketh, the Boro' Engineer of Blackpool, makes an exceedingly able reply in the *Blackpool Gazette* to Mr. Chew's recent criticism on the Blackpool electric works.

Bromsgrove Lighting. — Messrs. Hemming & Co., Birmingham, have asked permission of the Bromsgrove Local Board to put down electric light plant. The matter is being considered.

The Lighting of Brechin.—There is competition at Brechin, both the House-to-House Company, Glasgow, and the Northern Electric Light Supply Company are anxious to obtain Provisional Orders.

Electric Light Wanted at Darlington.—The inhabitants of Darlington are asking the town authorities to take up the supply of electricity. A committee is considering the matter.

Bristol Electrical Works. — The Local Government Board have at last sanctioned the borrowing of £24,650 for electric light purposes in Bristol. The inquiry was held in April last, when it was stated that of the amount mentioned, £9,000, was for additional expenditure, and the remaining £15,000 was to be devoted to making extensions.

The Position of the National Telephone Company in 1911.—Mr. Henniker Heaton, with his usual restlessness over telegraphic and telephonic matters, has extracted a fairly definite reply from the Postmaster-General on the position of the National Telephone Company. On the termination of the licence in 1911 the right of the company to carry on telephone business will cease. All they will have to sell will be their plant, and this the Government will be under no obligation to buy. This seems to effectually dispose of the goodwill question.

The Joule Studentship.—The President and Council of the Royal Society have, upon the recommendation of the Joule Studentship Committee, elected Mr. J. D. Chorlton, B.Sc., of Owens College, Manchester, to the first Joule Studentship.

The "New" Barnet Lighting.—Messrs. Joel & Co. are apparently so satisfied with what they accomplished at Barnet some years ago, that they have informed the Local Board that they propose to apply for a provisional order for the district. Possibly Mr. Joel's newly discovered "body currents," of which he seems to possess an inexhaustible supply, will be utilised in conjunction with transformer sub-stations.

Nikola Tesla.—Mr. Nikola Tesla has been made an LL.D. of Columbia College.

Lord Kelvin Honoured.—Lord Kelvin has been awarded the Grand Médaille of the Société d'Encouragement pour l'Industrie Nationale of Paris, for his scientific work.

Personal.—Mr. Manville was married yesterday at Newport to Miss Maude Wallis. We offer him our congratulations.

The City Inspectorship.—The appointment of City inspector rests between the three following gentlemen—Mr. T. A. B. Carver, Mr. G. Gerhardi, jun., and Mr. A. A. Voysey.

American Electro-Therapeutic Association.—The fourth annual meeting of the American Electro-Therapeutic Association will be held in New York, September 25th, 26th, and 27th, at the Academy of Medicine. Members of the medical profession are cordially invited to attend.

New Electrical Definitions.—An American contemporary says that the Scranton *Republican*, in a report of a trial for damages from an electric shock, gives the following as part of the testimony by experts:—"'Ohm' is the term used to show the resistance. 'Ampère' is the term used to describe a volt; a voltage of 1,500 would be styled an ampèrage of 10. A voltage of 6,000 would be required to propel an ampère three-quarters of an inch in length through a horse into a man under those conditions."

The Tunbridge Wells Tenders.—The following tenders have been accepted:—

	£	s.	d.
Boilers, Babcock & Wilcox	1,726	0	0
Steam pipes, Johnson & Phillips	277	10	0
Engines and dynamos, Johnson & Phillips ...	2,778	13	0
Switchboard, Crompton & Co.	428	10	0
Mains, Callender's	2,306	12	0
Arc lamps, Johnson & Phillips	989	1	6
Transformers, Crompton & Co.	832	14	0
Wiring of station, Crompton & Co.	46	0	0
	£9,385	0	6

A Rod in Pickle.—The *Pall Mall Gazette* of Wednesday says of the recent Harness litigation that:—"The case of 'Brasyer *v.* Harness and another' has come to a lame and impotent conclusion, the jury having failed to agree on all the salient points submitted to them so far as Harness is concerned. We shall have something to say on this trial, and especially upon the attacks made by Mr. Jelf, Q.C., on the *Pall Mall Gazette* in a case in which it was not concerned, and in which it was not and could not be represented by counsel. But we reserve our comments till Mr. Witt, who represented Colonel Brasyer, has decided what course he will adopt in face of the disagreement of the jury. Meanwhile we content ourselves with calling attention to one passsage in the report of the summing up of Mr. Justice Charles:—'It was clear that Harness had described himself as "a consulting medical electrician." It was no exaggeration to say that he had no medical knowledge; he had studied in no medical school, and under no doctor; he was in no sense a scientist. What was what he might call "the note of quackery?" Was it a profession that a single remedy would cure everything? His Lordship read a list of the ailments (including premature old age) said to be cured by the electrical treatment. Could any human being in his senses suppose that all those evils could yield to one treatment?' Let that suffice until it has been settled whether the issues are to be fought out anew before another jury."

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Birmingham House-to-House Electricity Company, Limited (29,225).—This company's yearly return, filed on May 9th, 1894, shows that out of a nominal capital of £100,000, in 19,900 ordinary and 100 founders' shares, all of £10 each, 107 shares have been taken up. Nothing has been called upon these; but £500 has been agreed to be considered as paid.

Bicester Electricity Supply Company, Limited (35,109).—A letter, bearing date May 23rd, 1894, has been filed at Somerset House, stating that the above company did not proceed to allotment in consequence of insufficient capital being subscribed.

Barnet and District Electric Supply Company, Limited (27,334).—The annual return of this company shows that out of a nominal capital of £5,000, in 490 £10 ordinary, and 100 £1 founders' shares, 80 ordinary and the whole of the founders' shares have been taken up. There has been £10 called on each of 60 ordinary, and £5 on each of the remaining 20 of the same class. A sum of £700 has been received, and £100 has been agreed to be considered as paid.

Brazilian Submarine Telegraph Company, Limited (6,886 C).—This company's annual return, filed May 23rd last, shows that out of a nominal capital of £1,300,000, in £10 shares, the whole of the shares have been taken up. The full amount has been called and duly paid.

Blakey, Emmott & Co., Limited (23,120).—According to a notice filed at Somerset House during last month, the registered office of this company is now at Prudential Buildings, Park Row, Leeds.

Bedford Electric Light Company, Limited (27,345).—The last annual return of this company shows that out of a nominal capital of £15,000, in 250 founders' and 14,750 ordinary shares, all of £1 each, 882 ordinary and 154 founders' shares have been taken up. There has been £1 called on each of the founders' shares, and 1s. on each of the ordinary. A sum of £197 19s. has been received; and 3s. is still unpaid.

American River Electric Power Supply Company, Limited (38,292).—This company, says a letter dated June 4th, 1894, which has been filed at Somerset House, has not proceeded to allotment, and all the money has been returned to the applicants for shares.

Edison Gower-Bell Telephone Company of Europe, Limited (16,010).—This company's last annual return shows that out of a nominal capital of £500,000 in £1 shares, 385,009 shares have been taken up; and that the full amount has been called on each of 15,009 of these. The sum of £15,005 has been received; £370,000 has been agreed to be considered as paid; and £4 is still outstanding.

Eclipse Electric Lighting Syndicate, Limited (25,831).—This company, according to a notice filed at Somerset House, has been wound up and its property disposed of.

Electrical Accessories Company, Limited (29,768).—This company's yearly return, filed March 26th last, shows that out of a nominal capital of £5,000 in £1 shares, 2,257 shares have been fully taken up, and that the full amount has been called on 757. A sum of £757 has been received, and £1,500 has been agreed to be considered as paid.

East Coast Electric Light and Power Supply, Limited (31,841).—Mr. V. B. D. Cooper informs the Registrar of Joint Stock Companies, that the above concern failed to obtain Parliamentary powers; that it has done no business, and that it has been abandoned.

BUSINESS NOTICES, &c.

The Electric Lighting on the Embankment.—At last Tuesday's meeting of the London County Council, the Highways Committee reported that they had considered the general description and specification of the engines, boilers, dynamos, and other machinery and plant which would be required for the generating station in connection with the electric lighting of the Victoria Embankment and Waterloo and Westminster Bridges, and had also had submitted to them an estimate of the cost. It appeared to them advisable that the supply of this machinery and plant should be the subject of two separate contracts, the one relating to the boilers and accessories, and the other to the engines, dynamos, &c.; and that, having regard to the extreme importance of the electric light installation being completed and in operation before the end of the year, tenders should be invited without any avoidable delay. They, therefore, recommended that the machinery and plant for the generating station required for the electric light installation for the Victoria Embankment and the Waterloo and Westminster Bridges be obtained; and that tenders for the supply of the said machinery and plant be invited by public advertisement. This was agreed to without comment. Mr. Roberts then moved: "That in the opinion of the council designs should be obtained for the electric lamp standards to be erected on the Victoria Embankment; and that it be referred to the Highways Committee to take the necessary measures for the purpose, and to advise the council what premium should be offered for the best designs." He said he was afraid that the committee were proceeding the wrong way to beautify the Embankment, and he felt that now that the council were giving such encouragement to technical education they should endeavour to obtain some real results from it. Perhaps nothing so readily yielded to artistic tastes as designs in ironwork, and he believed that if the council agreed to his motion they would have some very fine designs sent in. Mr. Powell seconded. Mr. Edwin Jones, the chairman of the committee, strongly opposed the motion; they had no necessity to go outside for designs when they remembered that the ironwork on the Embankment was designed in the council's offices. The motion was carried by 23 to 19.

The Electro-Medical Apparatus Company.—Under the failure of Alan Kirk, electrical engineer, who traded in partnership as above at St. Martin's Lane, W.C., accounts have been filed showing debts £328 2s. 2d., and available assets £3 10s. The debtor, who filed his petition on June 16th, has been adjudged bankrupt. He states that in July, 1892, his father purchased for him for £400 a third share (subsequently, on payment of a further £80, increased to half share) in the business of an electrical engineer; that the partnership was continued under the style of the "Electro-Medical Apparatus Company," at No. 36, St. Martin's Lane, W.C., until September last, when the firm's stock-in-trade and effects were seized for rent in arrear, and sold for £15 to the bankrupt's father, who it is stated now holds the same; further that he (the bankrupt) resumed business in November last as electrical engineer, at No. 23, Powis Street, Woolwich, and in March last took other premises at No. 34, Leicester Square, W. He appears to have given up the Woolwich premises in April last, but to have continued at the latter address until May 28th, when the landlord distrained and the business was abandoned. Since then he has been in employment as traveller at a weekly salary of £2 with a bonus, the amount of which has not yet been arranged. He attributes his insolvency to loss in trading in connection with the partnership and his own business. The books of account relating to the partnership have not yet been produced, and the bankrupt states that none have been kept since the dissolution. All the unsecured liabilities, with the exception of a trifling amount, are trade debts. The bankrupt states that his late partner has been unable to pay or effect an arrangement with the firm's creditors, and has left the country. The brankrupt also states that he has never owned any household furniture. At the first meeting of creditors held at the London Bankruptcy Court last Monday, the case was left in the hands of the Official Receiver to be wound up in bankruptcy. The 20th inst. is appointed for the public examination of the bankrupt.

Receiver's Liabilities. — Woodhouse & Rawson United, Limited, v. Jolin.—The plaintiff company, of 88, Queen Victoria Street, claimed, in the Lord Mayor's Court, the sum of £8 11s. 9d., for electric goods supplied to the defendants, Messrs. Jolin & Co., of Bristol. Mr. William Hicks, the solicitor for the plaintiffs, said that the claim was not in dispute, but the defendants had raised a counter-claim for goods supplied by them to the plaintiffs for a larger sum. The point was, that the goods which were the subject matter of the counter-claim were supplied before March 10th, 1893, when Mr. F. D. Leslie was appointed by the Chancery Division of the High Court as receiver of the plaintiffs company's business, in an action by the debenture-holders, with liberty to carry on the business. The question for the Court to decide was whether the defendants were entitled to set up against the receiver a claim which he could only prove against the defunct company, it being in liquidation. The Registrar adjourned the case, so that the point could be argued before the Judge with the view of its going to appeal. The case was adjourned.

Postal Boxes.—Manufacturers needing boxes for rail or post may be glad to know that Messrs. Nixdorff & Co., of 30, Maidstone Street, Hackney Road, devote special attention to this branch of packing case making.

Broughty Lighting.—The Northern Electric Supply Company having signified their intention to apply for a provisional order, the Police Commission have decided to call in an engineer.

Annual Outing.—On Saturday last the *employés* of Messrs. Rashleigh Phipps & Co. held their annual excursion. Proceeding by an early train to Brighton, a pleasant morning was passed in and upon the water, after which the company, numbering the whole of the available staff of the firm, sat down to dinner, at which the usual toasts were proposed. In the afternoon the party proceeded in brakes and carriages to the village of Southwick, where the annual cricket match between carpenters and wiremen was played on the village green. The weather was all that could be desired, and the whole affair passed off with the most perfect success. We may mention that this firm is at the present time particularly busy with the electric lighting of a large number of private houses, principally in the London district, and, notwithstanding the slackness usually prevailing at the present time in the electrical trade, the number of *employés* who attended the annual excursion exceeded last year's number by nearly 50 per cent.

Wellington Court, Knightsbridge.—The following tenders for wiring the above, according to specification and plans of Mr. Adrian Collins, Assoc.M.Inst.C.E., of 61, Old Broad Street, were sent in:—

	£	s.
Messrs. Julius Sax & Co.	1,668	0
Messrs. Bergthiel & Young	1,647	0
The Planet Company	1,474	0
Messrs. Raynes, Smith & Co.	1,394	0
Messrs. Vaughan & Brown	1,380	0
Messrs. Bolding & Co.	1,292	10
Messrs. Verity & Son	1,261	0
Messrs. H. Joel & Co.	1,200	0
Messrs. Crompton & Co.	1,114	0
Messrs. Spagnoletti & Crookes	1,090	0
Roger Dawson, Limited (accepted) ...	1,050	0

Agency.—Messrs. Crosier, Mills & Co., of Newcastle-on-Tyne and Sunderland, having been appointed agents on the North-East Coast for Messrs. Holden & Brooke, Limited, of Salford, they are making a special display of injectors and other steam specialities at 58, Collingwood Street, Newcastle-on-Tyne, where also they invite inspection of the Meldrum patent furnace, Richards side planer, the Morse valve reseating machine, and other labour and money saving devices.

Country House Lighting.—Elveden Hall, Suffolk, which has recently become the property of Lord Iveagh, is being fitted by its new owner with the electric light. About 500 incandescent lamps will be employed supplied from two steam engines and dynamos, and accumulators. The work is being carried out by Messrs. Edmundsons, Limited, under the superintendence of Mr. A. A. C. Swinton, who, as consulting engineer, has arranged the installation.

Electric Lighting in Halifax.—It is apparent that the new station will be well supplied with customers at the opening, for we hear that applications for current are already numerous. The Masonic Hall Management Committee have decided to light their place throughout, and have entrusted the work to Messrs. Walter Emmott & Co., of Thomas Street, Halifax.

Messrs. Roger Dawson, Limited.—We hear that Messrs. Roger Dawson, Limited, are exceedingly busy just now in all parts of town and country. Amongst other notable jobs, they are fitting up three large country houses, and also have a large contract in Dublin.

For Travellers.—The Commercial Travellers' Blue-Book, published at 1d. by Messrs. C. & E. Layton, besides giving valuable information as to market days, early closing days, population, and time of making up London mail, insures £100 in case of railway accident to the owner up to December 31st, 1894.

Printing Telegraph Company.—The case of the Printing Telegraph and Construction Company, Limited (*ex parte* Elvey), has been settled, it being agreed that an order should be taken striking out Mr. Elvey's name from the list of shareholders.

The Lighting of Yarmouth Parade.—It has been decided to place the arc lamps for the Marine Parade in the centre of the carriage way.

Stafford going Ahead.—The Electric Lighting Committee have asked the Mayor to lay the foundation stone of the dynamo room.

Theft of Telegraph Wire.—James Brindley, of the Telegraph Construction Corps, has been sent to prison for two months by the Birmingham stipendiary for stealing telegraph wire.

Cheltenham Tenders.—Messrs. Malvern's tender for the erection of the central station (£1,799), and the Callender's Bitumen Company for £1,031, has been accepted.

Cheltenham Engineer.—Mr. H. M. Kilgour has been appointed electrical engineer to the Corporation at £200 a year.

Proposed Electric Lighting at Walsall.—In furtherance of the Corporation's intention to supply light in the borough, the Local Government Board inspector held an enquiry last Friday. Mr. Cooper, the town clerk, said the borough was of a very scattered character, the total length being about seven miles, and an average breadth of about three miles. Over sixty miles of public highways were possessed. The system proposed to be adopted, was the high tension system, continuous current and accumulators on the low tension mains. The attention of the Council had been engaged for some time on the subject, and Mr. Frederick Brown was called in by them as adviser. It was upon his advice, and after having inspected some of the best electric lighting stations in London and the provincial towns that he came to the conclusion that the system was best adapted to the town of Walsall. Mr. Cooper (continuing) said they wanted a system capable of meeting the full requirements. Lying to the north of the borough there was practically another town containing about 12,000 people; he referred to Bloxwich. In all probability there would be a demand made upon them to supply that part of the borough. The scheme had been submitted to and approved by the Board of Trade. As to the site of the works, the Corporation proposed to appropriate part of the site of the Wolverhampton Street gasworks. Up to the present time, the town had been supplied with two gasworks, both belonging to the Corporation—one at Wolverhampton Street, which was an old works, established some forty or sixty years ago, and the other a modern works at The Plock, about twenty years old. This year the Corporation were abandoning the Wolverhampton Street works for the purpose of the manufacture of gas, but would still use them as a storage station.

The Climax Clinical Thermometer.—The only obstacles to perfection in previous clinical thermometers were the divisions and figures: firstly, because, being cut on the surface of the glass they held dirt, and possibly conveyed infection. Secondly, because constant wiping removed the black, and made it impossible to read the divisions and figures until they had been re-blacked. These two obstacles have been overcome by the new thermometer. The divisions and figures, instead of being cut on the glass are placed on a separate transparent scale, which is inserted in the body of the thermometer. The readings are therefore clear and distinct and will not fade, and there is no chance of conveying infection, because the perfectly smooth surface of the thermometer can retain nothing. The sole manufacturer is Mr. James J. Hicks, of Hatton Garden, who has been good enough to send us one of the instruments.

The Action against the National Telephone Company at Sheffield.—It will be remembered that a few weeks ago we briefly reported an action brought in the Sheffield County Court by the National Telephone Company against Morris Bros., chemical manufacturers, Doncaster, to recover rent due for the use of a private wire. There was a counter claim for £50 damages for inefficient service. Judgment was delivered by the County Court judge last week. His Honour said the claim for rent was admitted and judgment would be entered for that amount. With regard to the counter claim it was said that damage was caused by delay in communicating orders from the offices to the works. After reviewing the whole matter, his Honour said that the Telephone Company had performed their contract with extreme carefulness. Judgment was eventually given for the Telephone Company with costs on the higher scale.

Brewery Lighting.—An electric light plant consisting of an "Otto" gas engine (20 H.P. nom.), "Taunton" dynamo, "D.P" accumulator, Crompton-Pochin arc lamp of 3,000 C.P., and about 200 16-C.P. incandescent lamps has been completed at Messrs. Vaux and Son's brewery, Sunderland. Mr. R. Vaux, Bedford Works, Sunderland, carried out the work to the specification, and under the superintendence of Mr. G. W. Lummis-Paterson, Newcastle-on-Tyne.

The Cost of the Fleetwood System.—At the last meeting of the Fleetwood Commissioners it was stated that the estimated amount to be spent on building, &c., is £2,419 2s. 7d. The Brush Company's tender (including clerk of works) now amounts to £8,900, whilst £500 has been added to estimated expenditure, with a view of purchasing electrical fittings to be retailed to consumers. The total estimated expenditure on the installation will amount to £11,819 odd.

Messrs. Glover's New Offices.—The occasion of opening new offices, warehouses, and dining rooms at Messrs. Glover's Cable Works, Salford, was celebrated by a supper and entertainment given by Mr. H. Edmunds. Nearly 400 people met together and spent a most enjoyable time. In addition to offices and warehouses, the new buildings comprise stores for raw materials and for finished manufactures.

Electric Light at Scarborough.—The Scarborough Electric Supply Company, Limited, which has only been in operation about nine months, have already the equivalent of over 9,000 8-C.P. lamps connected to their mains. In order to meet further additions the directors have ordered from Messrs. C. A. Parsons & Co. another turbo-alternator to give 75 kilowatts, complete with condenser.

An Electrical Engineer's Failure.—A receiving order has been made at the London Bankruptcy Court against Edward Percival Oliver, electrical engineer, 50, Great Sutton Street, Goswell Road, trading as Newington, Priddle & Co. The petition was lodged by Mr. H. F. Oddy, acting on behalf of creditors, and no particulars transpired regarding assets and liabilities.

Dissolution of Partnership.—The partnership hitherto subsisting between William Thomas Burbey, Albert Edward Williamson and Edward Lionel Joseph has been dissolved so far as regards William Thomas Burbey. The business will be carried on by the two remaining partners.

Catalogues and Price Lists.—Messrs. Drake & Gorham have sent us their revised catalogue, which contains useful and complete data for country house lighting, a battery list and illustrations and information concerning their switches and recording instruments.

We have also received various price lists from Messrs. W. T. Glover and Company.

Messrs. John Davis & Son, All Saints Works, Derby, also send us a catalogue which bears evidence of the extensive character of Messrs. Davis's *clientele*.

A complete catalogue of electrical plant is to hand from Messrs. Russell & Co., of Queen Victoria Street.

Messrs. Little & Co., of Kensington, have sent us a list of their specialities, which include special bells, medical coils, &c.

Personal.—Mr. Percy Rosling, of Rosling and Matthews, Bradford, was married on the 4th of this month to Miss Amy Beatrice Phillip, eldest daughter of Mr. Adolphus Phillip, of Bradford. The men employed at the works commemorated the event by presenting Mr. Rosling with a spirit case, and by having an excursion to Bolton Woods.

Manchester Ship Canal.—We learn that the Acme and Immisch Electric Works, Limited, of Chalk Farm, have just completed a combined engine and dynamo plant for a new ship which is being built for the ship canal traffic. They are also busy with an additional 150 H.P. mining plant for their South African agency.

The Lighting of Queen's Hotel, Hastings. — The following is the list of tenders for electric light fittings for the Queen's Hotel Hastings: J. Barker & Co., London, £411; Strode & Co., London, £346 11s.; Local Supply Company, £345 18s. 4d.; A. Hands, London, £310 9s. 9d.; B. Verity & Sons (accepted), £306 19s.

Lighting of Salterforth Shed Company's Works.—Messrs. Briscoe & Shaw have obtained the contract for lighting the whole of the Salterforth Shed Company's buildings with the electric light, with one of Rosling & Matthews 300-light dynamos.

The Proposed Purchase at Fareham.—The ratepayers do not relish the proposal of the Local Board to purchase the electric light company's undertaking without a proper valuation. The Board of Trade have been petitioned on the matter.

Sale by Auction.—Messrs. Wheatley Kirk, Price & Goulty will sell by auction a quantity of machinery and engines at the Vulcan Iron Works, Market Square, St. Neots, Hunts, on Tuesday, Wednesday, and Thursday of next week.

Worcester Electric Lighting.—There was a good deal of discussion at a recent meeting of the Town Council as to whether the Guildhall should be wired for the electric light. The progressives got the best of the argument.

Bills in Parliament.—The Wakefield, the Crystal Palace, the Chelmsford and Guildford, electric lighting orders have been reported for third reading. The Plymouth Electric Lighting Bill has reached committee stage.

Lighting of Pontypool Market Place.—Messrs. F. W. Ball & Co., Bristol, have secured the contract for lighting the Market Place at Pontypool with 4 arc lamps, and between 50 and 60 32-C.P. incandescent lamps.

The Lighting of Lancaster District.—The Windermere and District Electric Light Company intend to apply for powers to light the district controlled by the Lancaster Rural Sanitary Authority.

Electricity at Montrose.—The Northern Electric Supply Company consider Montrose to be a likely place in which to pitch their tent, and they propose to apply for a Provisional Order to do so.

Enquiry at Walsall.—A Local Government Board inspector has enquired into Walsall's proposal to borrow £22,000 for electric lighting purposes.

The Islington Station.—Mr. A. H. Tiltman's designs for an electric lighting station have met with the Lighting Committee's approval. Building tenders will shortly be invited.

Grasmere Lighting. —The Windermere and District Electric Light Company are anxious to supply electrical energy to the district of Grasmere, and will apply for powers.

Scientific Instruments in Aluminium.—Mr. W. F. Stanley, of Great Turnstile, Holborn, is making many of his scientific instruments in a special aluminium alloy.

The Position at Bolton.—It was mentioned at the last meeting of the Town Council that in a few weeks' time the public supply of electricity will be available.

Electricity in the West of Ireland.—We hear that a company has been formed for electrically lighting Ballinrobe, Ballyhaunis, Claremorris, and Tuam.

Colliery Lighting at Alloa.—The Alloa Coal Company have had their colliery at Sanchie, near Alloa, lighted by electricity.

Electric Light for Paddington Streets.—The Vestry are enquiring into the cost of lighting the streets by electricity.

Infirmary Lighting.—The new Union Infirmary at Dewsbury will be completely equipped with the electric light.

Electric Lighting at West Hartlepool.—The Town Council have decided to apply for a provisional order.

Anglo-American Cable.—A financial contemporary, of the 10th inst., states that the steamer *Brittania* has arrived at Heart's Content, Newfoundland, with 190 miles of cable for the new Anglo-American cable.

The Introduction of Lighting into Ramsgate.—The Town Council will oppose the Brush Company in its efforts to introduce electric lighting into Ramsgate.

Salisbury Lighting.—With regard to the private company which is pushing on the matter of lighting, the Council have decided to call in an engineer to aid them in negotiations.

Extensions at Rugby School.—The Rugby School Electric Lighting Company are extending the lighting into the new science department, lecture rooms, &c., which are being built.

Private Enterprise Discouraged at Ambleside.—The Ambleside Local Board will not sanction the application of the Troutbeck Bridge Works and the Holloway Works for lighting orders.

The Chesterfield Lighting Bill.—This bill, which provides for local lighting, has received the Royal assent.

CONTRACTS OPEN AND CLOSED.

OPEN.

Carshalton.—For the lighting of their district (consisting of the entire area of the parish of Carshalton) with gas, oil, or other illuminant, at per lamp, exclusive of the cost of columns, frames and lanterns, for 12 months from 31st inst., for the Local Board. Tenders, marked "Public Lighting," and addressed to the chairman of the board, must be delivered at the board offices, High Street, at or before 12 noon on 18th inst. Mr. Chas. P. Lovelock, clerk.

Rugeley (Staffordshire).—For lighting the street lamps for the winter season, commencing September 1st, 1894, and ending April 30th, 1895, for the Rugeley Local Board. For particulars, apply to the Chairman of the Lighting Committee, Local Board, Rugeley, to whom tenders should be sent by August 1st. Mr. Robert Landor, clerk.

Watlington (Oxon.)—The Lighting Inspectors invite tenders for lighting streets, roads, and other places comprised in the parish, either with oil or with gas, or any other material. Tenders should be sent forthwith in a sealed letter, addressed to the Inspectors, Market Place, Watlington, of whom the fullest particulars may be obtained, and must be in accordance with instructions to be obtained at the office.

Woking.—July 18th. For the lighting of the Woking Station and Maybury Ward for the Woking Local Board. A draft of the proposed contract can be inspected at the office of Mr. Robert Mossop, clerk, Bank Chambers, Woking. Tenders, marked "Tenders for Lighting," must be received by the clerk on or before 18th inst.

Tunbridge Wells.—For erection and completion of an electric light station and chimney shaft, to be erected on a site in the Quarry Road, Tunbridge Wells, for the Corporation, in accordance with the drawings prepared by Mr. Arthur Ardron, F.R.I.B.A., 39, Victoria Street, Westminster. The drawings and specification may be inspected at the offices of Mr. W. C. Cripps, town clerk, Town Hall, Tunbridge Wells, or at the architect's offices. Persons wishing to tender are requested to send their names to the town clerk, with a fee of £2 2s., on or before 16th inst., for which fee complete bills of quantities will be forwarded in due course, and the fee will be returned on receipt of a *bonâ fide* tender. The person or firm whose tender is accepted will be required to enter into a formal contract and a bond with two approved sureties for the performance of contract. Sealed tenders, endorsed "Electric Light Station," must be sent to the clerk by 12 noon on 27th inst.

CLOSED.

Guildhall Lighting, Worcester.—The tender of the New British Electric Installation Contractors for wiring the Public Hall, Small Hall, &c. (£177), and the tender of Messrs. Verity and Sons for fittings (£154) have been accepted.

CITY NOTES.

Eastern Telegraph Company, Limited.

The report of the directors for the half-year ending March 31st states that the revenue amounted to £389,314, from which are deducted £102,219 for the ordinary expenses and £49,660 for expenditure relating to repairs and renewals of cables, &c. After providing £3,220 for income-tax, and £401 due to re-valuation of currency balances at stations, &c., there remains £233,814, to which is added £86,252 brought from the preceding half-year, making a total available balance of £320,066. From this surplus there has been paid £27,680, interest on debentures and debenture stock; £20,384, dividend on preference shares; and £50,000, an interim dividend of 2s. 6d. per share on the ordinary shares; a total of £98,064, leaving £222,002, from which £110,000 has been carried to the general reserve fund. The directors now recommend the declaration of a final dividend of 2s. 6d. per share and a bonus of 3s. per share, amounting together to £110,000, free of income-tax, and making, with the three previous payments on account, a total distribution of 13s. per share, or 6½ per cent. for the year on the ordinary shares. The balance of £2,002 is to be carried forward. The revenue includes £32,791 dividends and bonus for the half-year upon the investments in the Eastern and South African, the Black Sea, the Direct Spanish, and the African Direct Telegraph Companies.

West African Telegraph Company, Limited.

The directors' report for the year 1893 states that the revenue for that period amounted to £61,847, against which £18,829 is charged for ordinary expenses, and £20,492 for expenditure relating to repairs to cables, &c. After providing £1,026 for income tax, and £214 due to re-valuation of currency balances at stations, there remains a balance of £21,285, to which is added £2,410 brought forward, making a total balance of £23,695. From this balance there is deducted £12,495 for interest on debentures, and £11,200 for sinking fund. The total expenses attending repairs and renewals of cables, &c., amounted to £31,234, but the directors after careful consideration have decided to apply from the general reserve fund the sum of £10,741, to meet the deficit which would otherwise have appeared after providing for the ordinary expenses, interest, and sinking fund for debentures, as well as for the expenses incurred in repairing the cables. It will be seen from the accounts that there has been a loss on exchange of £7,751, against £8,044 last year. The depreciation of Portuguese currency continues to seriously affect remittances from abroad.

The National Telephone Company, Limited.—Subject to final audit, the directors have resolved to recommend a dividend, less income tax, for the eight months ending June 30th, 1894, at the rate of 6 per cent. per annum on the first and second preference shares, at the rate of 5 per cent. per annum on the third preference, and at the rate of 5 per cent. per annum on the ordinary, making, with the interim distribution, 5 per cent. per annum for the fourteen months ending the 30th ult., and leaving a balance of about £67,000.

City of London Electric Lighting Company.—The returns for the June quarter show that the revenue from the sale of current for public lighting amounted to £3,162, as compared with £2,838 for the corresponding period of last year; and the revenue in respect of private lighting £7,153, against £3,074. The total is £10,315, an increase of £4,401.

Submarine Cables Trust.—On and after July 13th the sum of £1 5s., balance of the coupon due April 15th last, will be paid by Messrs. Glyn, Mills & Co., of 67, Lombard Street. The coupons should be left with the bankers for examination four clear days before payment.

National Telephone Company.—A dividend at the rate of 5 per cent. per annum is announced on the ordinary shares for the eight months ended June 30th, a balance of £67,000 being carried over.

Globe Telegraph and Trust.—This company announces a dividend of 3s. per share on preference, and 3s. 9d. on ordinary shares, carrying forward £500.

The Direct United States Cable Company, Limited.—The board have resolved to recommend a final dividend of 2s. per share, free of income tax, such dividend to be payable on and after the 25th instant, making, with the interim dividends already paid, 2⅝ths per cent. for the year ending June 30th last, and after placing £6,000 to reserve fund account, carrying forward a balance of £1,031 17s. 2d.

The Edison and Swan United Electric Light Company, Limited.—The eleventh ordinary general meeting of the shareholders will be held at the Cannon Street Hotel, E.C., on Thursday, July 26th, 1894, at 11 o'clock a.m., to transact the ordinary business of the company.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending July 8th, 1894, amounted to £879; week ending July 9th, 1893, £1,069; decrease, £190; total receipts for half-year, 1894, £879; corresponding period, 1893, £1,069; decrease, £190.

The Great Northern Telegraph Company. The traffic receipts in June, 1894, were £24,000; January 1st to June 30th, 1894, £129,800; corresponding months, 1893, £132,800; corresponding month, 1892, £128,800.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 6th, after deducting 17 per cents. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,378.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, July 4th.	Closing Quotation, July 11th.	Business done during week ended July 11th, 1894. Highest.	Lowest.
184,500£	African Direct Teleg., Ltd., 4 % Deb.	100	...	...	...	100 —103 xd	100 —103	...	...
1,134,640£	Anglo-American Teleg., Ltd.	Stock	£2 12s.	£2 15s.	£2 11s.	38 — 41	37 — 40	37	...
2,932,680£	Do. do. 6 % Pref.	Stock	£5 5s	£5 10s.	£5 2s.	72 — 74	71 — 73	73½	72
2,932,680£	Do. do. Defd.	Stock	...	...	...	6½ — 7	6½ — 7	6¾	...
130,000	Brazilian Submarine Teleg., Ltd.	10	8 % §	6½ % §	6½ % §	12 — 12½xd	12 — 12½	12 5/16	12
18,700£	Do. do. 5 % Bonds	100	...	...	...	101 —104	101 —104	...	...
75,000£	Do. do. 5 %, repayable June 1906	100	...	...	...	107 —111 xd	107 —111	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 40,000	5	... §	10% ‖ §	... §	1½ — 2½	1 — 2	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	139 —143	139 —143	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	3½ % §	2 % §	2 % §	1/16 — 3/16	1/16 — 3/16	1/8	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12 — 13	12 — 13	12¼	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½ — 19½	18½ — 19½	19¼	...
12,931	Direct Spanish Teleg., Ltd., £4 paid	5	4½%	4 %	4 %	4 — 4½	4 — 4½	...	...
6,000	Do. do. 10 % Pref.	5	10 %	10 %	10 %	9 — 9½	9 — 9½	...	...
60,710	Direct United States Cable, Ltd., 1877	20	3½ % §	3½ % §	...	8½ — 9½	8½ — 9½	9 3/16	8⅝
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½ % §	6½ % §	...	15 — 15½	15½ — 15½	15 7/16	15
70,000	Do. 6 % Pref.	10	6 % §	6 % §	...	15⅝ — 16¼	16 — 16½	16 3/16	16
105,900£	Do. 5 % Debs., repay. August, 1899	100	...	...	...	107 —110	107 —110	...	...
1,294,100£	Do. 4 % Mort. Deb.	Stock	...	...	...	113 —116	114 —117	116½	114
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	15¼ — 15½	15½ — 15¾	15⅝	15¼
62,700£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	...	...	...	103 —106 xd	103 —106	...	...
222,800£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	...	...	...	103 —106 xd	103 —106	...	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	114 —118	114 —118	...	...
95,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	...	...	...	103 —106 xd	103 —106	...	...
129,100£	Do. do. do. to bearer, 2,344 to 5,500	...	...	...	...	103 —106 xd	103 —106	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909	100	...	...	...	105 —108	105 —108	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	...	...	...	107 —110%	107 —110%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	5⅛ % §	4⅞ % §	4⅝ % §	8¼ — 8½	8¼ — 8½	9½	8¼
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 % §	15⅛ — 15⅜	15¼ — 15½	16⅜	15 5/16
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜ % §	8⅜ % §	8⅜ %	20½ — 21 xd	20½ — 21	21	20¼
200,000£	Do. do. do. 5 % Debs.	100	...	...	...	105 —108	105 —108	107¾	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	43 — 45	44 — 46	45	44½
37,548	London Platino-Brazilian Teleg., Ltd.	10	...	...	...	5 — 7	5 — 7	...	...
100,000£	Do. do. 6 % Debs.	100	...	...	...	107 —110	107 —110	...	...
15,000	Monte Video Teleph. Co., Ord., 1 to 15,000	5	...	...	...	½ — 1½	½ — 1½	...	...
28,000	Do. do. 6 % Pref., 1 to 28,000	5	...	...	...	1 — 2	1 — 2	...	...
484,597	National Teleph., Ltd., 1 to 438,984	5	6 % §	5 % §	...	4⅞ — 5⅛	4⅞ — 5⅛	5 1/16	4⅞
15,000	Do. 6 % Cum. 1st Pref.	10	...	...	...	15 — 16	14½ — 15½	15 7/16	...
15,000	Do. 6 % Cum. 2nd Pref.	10	...	...	...	14½ — 15½	14 — 15	14⅞	14⅝
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 90,950	5	...	...	...	5⅜ — 5⅞	5⅜ — 5⅞	5⅝	5⅜
925,017£	Do. 4½ % Deb. Stock Prov. Certs. ...	...	...	...	...	109 —112 xd	109 —112	...	...
48,800	New Teleph., Ltd., 25,901 to 74,700; £4 paid	10	...	...	...	... ...	... ...	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	...	⅛ — ¼	⅛ — ¼	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	...	...	...	101 —104 xd	101 —104	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	...	5 — 6	5 — 6	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	110 —115	110 —115	...	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	1½ — 2	1 — 2	...	...
146,370£	Do. do. 5 % Debs.	Stock	...	...	...	90 —100 xd	90 —100	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	..	...	3 — 5	3 — 5	...	...
249,900£	Do. do. do. 5 % Debs.	100	...	...	...	102 —105	102 —105	...	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	2½ — 3	2½ — 3	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	...	...	...	96 —101 xd	96 —101	...	...
64,242	Western and Brazilian Teleg., Ltd.	15	4 %	2½%	5 %	6½ — 7	6½ — 7	...	...
33,129	Do. do. do. 5 % Cum. Pref. ...	7½	...	...	...	5¾ — 6¼	5¾ — 6¼	...	...
33,129	Do. do. do. 5 % Def.	7½	3 %	...	...	1¾ — 2¼	1¾ — 2¼	...	...
178,200£	Do. do. do. 6 % Debs. "A," 1910 ...	100	...	...	...	107 —110	107 —110	109¾	...
222,700£	Do. 6 % Mort. Debs., series "B," red. Feb. 1910	100	...	...	...	107 —110	107 —110	...	...
88,321	West India and Panama Teleg., Ltd.	10	¼%	¼%	⅜%	1 — 1¼	1 — 1¼	1⅛	1 1/16
34,563	Do. do. do. 6 % 1st Pref. ...	10	...	...	...	10 — 10⅛	10 — 10⅛	...	...
4,669	Do. do. do. 6 % 2nd Pref. ...	10	...	...	..	9 — 10	9 — 10	...	...
80,000£	Do. do. 5 % Debs. (1917) No. 1 to 1,000	100	...	...	...	107 —110 xd	107 —110 xd	109¾	...
$1,214,000	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	...	...	...	115 —120	115 —120	...	...
169,000£	Do. do. 6 % Ster. Bonds.	100	...	...	...	100 —104	100 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

20,510	Charing Cross and Strand Electy. Supply, 1 to 6, 215 to 718, and 10,001 to 30,000	5	...	5 %	4½ %	4½ — 5½	4½ — 5½	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	...	12½ — 13½	12½ — 13	...	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	...	6 %	6 %	13¾ — 14½	14 — 14½	14⅛	...
100,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	127 —130 xd	127 —130	...	...
45,000	†Liverpool Electric Supply, £4 10s. paid	5	4½%	5 %	5 %	6⅜ — 6½	6⅜ — 6½	...	...
49,900	*Metropolitan Electric Supply, Ltd., 6,101 to 50,000 ...	10	1 %	2 %	2½%	8¼ — 9	8½ — 9	...	...
100,000£	Do. 5% Deb., 1 to 10,000 in bonds of £10, £20, £40	...	...	...	...	108 —111	109 — 112	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	...	4½ — 5½	4½ — 5½	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780	5	8½%	7½%	4½%	7 — 7⅛	7 — 7⅛	..	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8¼ — 9	8½ — 9	8⅝	...
59,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	...	3½%	4 %	6¼ — 6¾	6¼ — 6¾	6½	...

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, July 4th.	Closing Quotation, July 11th.	Business done during week ended July 11th, 1894. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	...	6 % §	6 % §	2⅞— 3	2¾— 3	2 13/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	...	6 % §	6 % §	2⅛— 2⅜	2⅛— 2⅜	2 5/16	2 3/16
125,000/	Do. do. 4½ % Deb.	Stock	...	...	...	109 —112	109 —112	...	...
630,000/	City and South London Railway	Stock	...	⅝%	⅝%	36 — 38	36 — 38	...	...
20,000	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 20,000	5	7 % §	7 % §	7 % §	2¾— 3¼	2½— 3	...	...
50,000/	Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	...	...	...	95 —100	95 —100	...	...
120,000	Electric Construction, Ltd., 1 to 120,000	2	...	...	...	¼— ⅜	¼— ⅜	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	...	...	...	1½— 1⅝	1½— 1⅝	...	...
100,000	Elmore's French Patent Cop. Deposg., Ltd, 1 to 66,750 ...	2	*nil*	*nil*	*nil*	¼— ⅜	¼— ⅜	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil* ¶	*nil*	*nil*	1⅜— 1⅝	1 — 1¼	1 1/16	...
67,385	Elmore's Wire Mfg., Ltd., 1 to 67,385, issued at 1 pm. ...	2	*nil*	*nil*	*nil*	¼— 1½	7/16— 1⅛	⅝	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	*nil* §	½— 1½	½— 1½	...	...
9,600/	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	...	...	6½— 7½	6½— 7½	...	...
6,837	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	5 %	6½— 7½	6½— 7½	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	12½%	23½— 24½	23½— 24½	24	23¾
200,000	Do. do. do. 4½ % Deb., 1896	100	...	...	...	103 —105	103 —105	105	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	...	1 %	8¼ — 8½	8 3/16— 8 5/16	...	...
6,295	† Do. do. Pref., £8 paid	10	...	...	...	12⅞— 13½	12⅞— 13⅛	...	...
78,949	Swan United Electric Light, Ltd., £3½ paid	5	11 % §	10 % §	7½% §	... — ...	2 — 2½	...	...
37,250	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	20 %	40 — 42	40 — 42	41½	...
150,000/	Do. do. do. 5 % Bonds, red. 1894	100	...	...	...	102 —105 xd	104—107	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £2 paid ...	10	...	...	...	2 — 2¼	... ...	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%§; 1891—7%§; 1890—8%§.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¼—5⅜.

Electric Construction Corporation, 6 % Debentures, 87—92.

Electric and General Investment, shares of £5 (£1 paid), 1¾—2¼.

Electricity Supply Corporation, Ordinary of £5, 5—5¼.

House-to-House Company (£5 paid), 1—1½.

Do. do. 7 % Preference, of £5, 5½—5⅝.

Do. do. 6 % Debentures of £100, 101—103.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 4⅜—5¼; 1st Preference Cumulative 6 %, £5 (fully paid), 6¼—6⅜.

Liverpool Electric Supply, £5 (fully paid), 6½—6⅝.

Do. do. £3 10s. paid, 4½—4⅝.

London Electric Supply Corporation, £5 Ordinary, ⅞—1⅛.

Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 101—103.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares (£4 10s. paid), 4½—4⅝.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

NAVAL DYNAMO MACHINERY.

The steady development of marine dynamo machinery and the number of applications opening for its further use aboard men-of-war, render the subject of direct importance to every student of electrical engineering or of naval construction and equipment. Much may be learned by studying the systems and electrical apparatus in use in different European navies and in America. Hence a notice of a recent paper by Lieut. J. A. Murdoch, U.S.N., on this subject, may not be without interest. And the United States Navy affords a suitable *locus* of examination, for an inspection of the European naval electrical plant in 1891, followed by duty at the New York Navy Yard, where the systems in use in nearly all the vessels of the navy have come under his inspection, have convinced Lieut. Murdoch that the American electrical plants are in most respects superior to those in use in other navies, although they appear to deteriorate more rapidly. Most of the information, however, is drawn from the specifications published by the Bureau of Navigation and the Bureau of Equipment in the Naval Intelligence Annuals.

The Engines.

The construction of the engines has proved usually to be too light; strength has been unduly sacrificed to decreased weight. The engines that are now being installed are consequently much heavier than formerly; they have more clearance in the cylinders, and although this is not economical so far as steam is concerned, it is of value when working with wet steam, or when threatened with water. As the presence of water in the cylinder has always been a cause of damage to dynamo plants, special attention is now given to drainage, and the cylinders are fitted with both hand and automatic relief valves. The governor is of the common automatic type, the weights being placed in a wheel midway between the cranks. [The closest regulation has been obtained from the 24-kilowatt sets, which average only five revolutions, change of speed from full load to no load, the momentary increase when all load is thrown off suddenly being only eight revolutions.] The pistons are without packing rings, and though four sizes of engine are used, namely, with cylinder diameters of 13, 10¾, 8½, and 6½ inches, they all have the same stroke, 6 inches.

The Dynamos.

Four-pole compound-wound dynamos are now being specified. Of these, the frame and field cores are made of cast-steel in one piece, the pole pieces being bolted on. The field coils are cylindrical, and wound on "vulcasbeston" spools, the spools of the small machines being coned to save space. The series coils are next to the core, the ends being brought out directly opposite each other, and all four spools are coupled in series. The shunt winding is outside the series, and the spools are also in series. [This arrangement facilitates repairing.] The shape of the field frame and the position of the coils are such as to minimise all external magnetic field. No magnetism can be detected on the outer parts of the frames, except in one or two positions, and the external field is imperceptible on a "horizontal force" instrument at a distance of 15 feet. [This policy of preventing magnetic effect appears to possess decided advantages over attempts to counteract it.]

The armatures are Gramme-wound, and slide off and on a shaft common to both engine and dynamo, being secured by a feather and slot, and kept in place by set screws. Each is built up of soft iron discs, clamped together, there being no through bolts. The winding is made with stranded conductors, each wire being separately insulated before stranding. The effects of these improvements is to bring the total core losses below 700 watts, and heating on the full load run of four hours to about 45° Fah.

The commutator is of bronze, the number of segments varying from 120 to 144 in the different sizes. It has cross connections inside for use with two sets of brushes.

As a result of the range of steam pressure called for under the engine specification, and of the low heating limit allowed for the dynamo, the generating set possesses great reserve power. In one of the official tests, while operating two 200-ampère dynamos in multiple with about 80 lbs. of steam, the whole load of 400 ampères was inadvertently thrown on one dynamo. No noticeable diminution of speed of the engine occurred, nor was there any sparking on the dynamo, the overloading being only manifest on the ammeter. When the double load of 400 ampères was thrown off, it was not necessary to adjust the brushes, the sparking being insignificant. This capacity for carrying an overload is of the greatest value in ship-work, as in case of damage to one set, all the work could be done by another. There is no question of the capacity of the dynamo to carry 150 per cent. of its rated load for long runs without material damage, nor is there any lack of power in the engine. In any particular case the amount of safe overloading would probably depend upon the heating of engine bearings and crank-pins.

All the dynamos yet used in the United States Navy have been fitted with rheostats in the shunt field, to admit of variation of the voltage. An adjustable resistance in parallel to the series field is also authorised on board ship when the dynamos are required to operate in parallel.

II.

Wiring.

The greatest care has always been exercised in wiring the vessels of the United States Navy, and the standards of insulation and general workmanship are of the very highest order. And this in spite of the prevailing high wages and short working hours.

The general system of wiring is to run two sets of circuits. One set, called the "battle circuits," includes all lamps necessary in action. These circuits generally include all lights in fire and engine rooms, coal bunkers and store-rooms below the protective decks, lights not needed in action being turned off separately. All exposed lights, and those used for ordinary illumination, are put on the "lighting circuits." The ends of the "battle mains" are interlocked at many places, and the circuits are kept as much as possible below the protective deck. The number of circuits at the switchboard has been decreased of late by the use of "feeders." These are heavy conductors leading from the dynamo room to the general location to be lighted, where, by means of a "feeder junction box," they branch right and left into the "mains." Each pair of mains may have a feeder box placed in it, thus allowing its division into two other pairs of mains. [These boxes contain no fuses, and the mains leading from them must therefore have a safe carrying capacity equal to that of the feeder fuses at the main switchboard.] Switches are interposed in the mains as desired, and if many switches exist on the lighting circuits the feeder boxes and switches are recommended to be placed together in sub-stations. Subdivisions or branch mains are taken off the mains by means of ordinary junction boxes, each of which contains a fuse. Similarly branches may be taken from the branch mains.

All wires are enclosed in pine mouldings, there being at least $\frac{3}{4}$ inch of wood between the wires and $\frac{3}{8}$ inch between either wire and any metal connected with the ship. As a rule, all fixtures are secured on wood, avoiding a heavy ground in case of low insulation resistance on the sockets or other metal parts. [Of late commercial ceiling fixtures, ceiling cut-outs, and non-watertight junction boxes have been installed in quarters where their use does not impair the insulation efficiency of the plant, with the idea of avoiding the expense and loss of light attendant on the use of standard water-tight fixtures.]

The search-light leads extend from the switchboard directly to the projectors, or to the control stands, being broken at intervals of about every 50 feet for convenience in installation, the ends being joined in search-light junction boxes, which contain no side holes and no fuses, being simply used to avoid splices.

The standard wire employed used to be lead-covered; this is now done away with, because it did not prove satisfactory, either as a waterproof covering, or as a protection from injury. Moreover, the lead covering practically put all grounds in parallel, and was also objectionable from its extra cost and weight. The wire now employed has a heavy insulation of vulcanised rubber, and a covering of waterproofed braid. [This wire is, of course, to a certain extent experimental, and if experience should prove it to be inferior to wire of the same grade covered with lead, the latter might be again resorted to.]

The standard of insulation resistance called for is one megohm on each circuit, and 500,000 ohms on all in parallel. This is not only a guarantee of good material and careful workmanship, but also ensures against accident.

In laying out the wiring, the size of the wires is determined under three provisions of the specifications. One stipulates that no single conductor shall be smaller than No. 16 B.W.G. The second calls for a cross-section of 1,000 circular mils. (1 square inch = 1,273,236 circular mils) for each ampère of current at full load, authorising a double current in the search-light leads. The third call for such a cross-section that the fall in potential between the dynamo and the farthest lamp shall not be more than 3 per cent. on full load.

When the installation of a vessel is laid out, the calculations are made on the area of the conductors in circular mils. As stranded cables are used for all sizes above No. 14 B.W.G., results cannot be expressed in terms of diameter. The exact area required cannot always be obtained in stranded cables, and the nearest size admitting of convenient manufacture is therefore taken. The ruling condition of manufacture of stranded cables is that the cable must consist of 7, 19, 37, or 51 wires, if all are of equal size. By varying the size of each of the component wires, stranded cables of any desired cross-section may be made.

The following are the sizes of conductors commonly used in the service:—

	Circ. mils.
No. 16 B.W.G.	4,225
„ 14 „	6,889
„ 20—30 B.W.G. flexible cord	2,880
„ 7—22 B. & S. „ „	4,498
„ 7—20 B.W.G.	8,575
„ 7—18 B. & S.	11,368
„ 7—19 B.W.G.	12,348
„ 7—16 B. & S.	18,080
„ 7—17 B.W.G.	23,548
„ 7—16 „	29,575
„ 7—15 „	36,288
„ 19—18 „	45,619
„ 19—17 „	63,916
„ 19—16 „	80,275
„ 37—18 „	88,837
„ 37—17 „	124,468
„ 37—16 „	156,325

PRESENT AND PROSPECTIVE STEAM ENGINE ECONOMY.

With the tendency to lapse into prophecy that is characteristic of the American writer, Professor Barr discusses the future of the steam engine in *Cassier's Magazine*. Starting with the statement that the birth of the modern steam engine was about contemporaneous with the birth of man's "greatest political institution," to wit, the American Republic, he goes on to trace the development up to the year 1900. The parallel is a trifle unfortunate. The gigantic failure of the political institution, its conversion in one short century to a mere plutocratic tyranny, should have warned our professor not to have dragged into a mechanical comparison any reference to political institutions, no matter how good at their inception. He borrows a diagram from Professor Thurston, showing pressures from the year 1800 to the year 1900. For the year 1890, the pressure is 200 lbs. absolute, to which it had risen from 20 lbs. in 1800, and the curve of the diagram up to the year 1900 shows 320 lbs. as the pressure. There is, he says, strong presumptive evidence this will be attained. Seeing that the curve of this diagram already gives evidence of reversion, the presumption is that it might become simply an S curve, and continuing it roughly on this basis, shows that for the next 100 years we may expect merely an additional pressure of 70 or 80 lbs. to a total of 380 lbs. This conclusion is at least as logical as that of Professor Barr's, for the

pressures now being approached are accompanied by such high temperatures that other than mechanical difficulties bar the road of rapid progress.

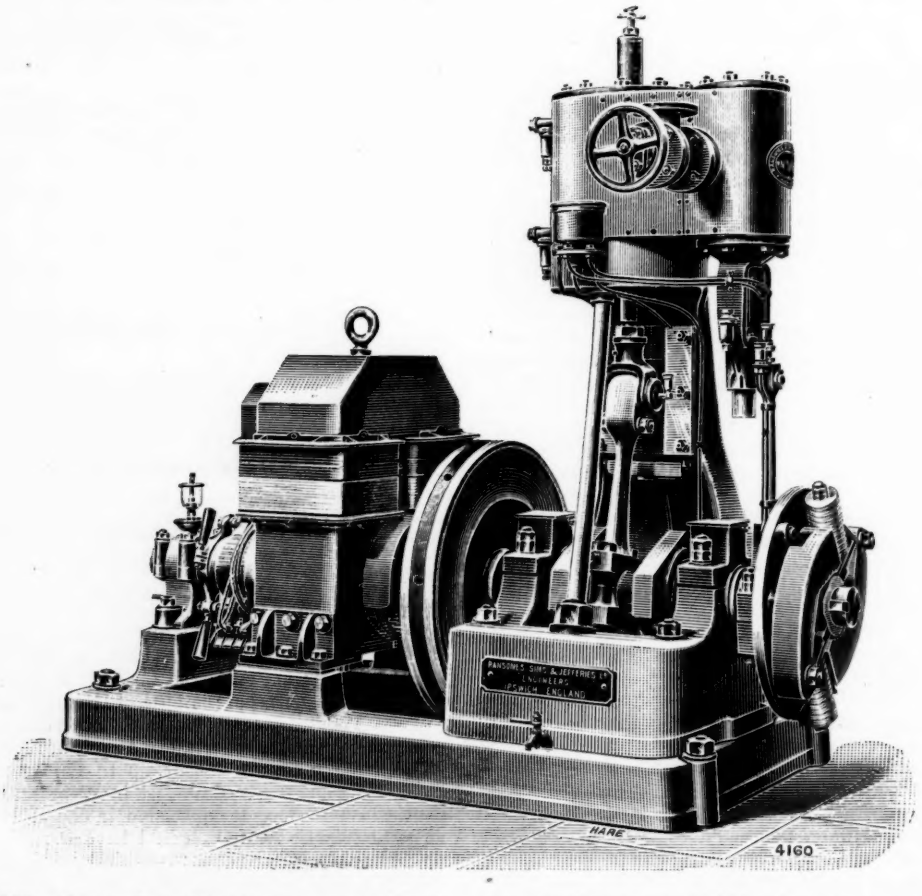
It is for these reasons that a moderation in the rate of increase of pressure may be anticipated. Very little weight need be given to the argument that welded boiler seams add a large percentage to the effective strength of plates. As soon as the demand arises, we shall be able to order boiler plates, rolled solid without need of welded longitudinal seams. Until a new material for boilers is forthcoming, it is at the boiler we must look for our limit of pressure. Like all professors trammelled by the narrow teachings of a merely mathematical conception of mechanics, our author plumps for the water tube boiler, and he states that seeing the Cunard boilers carry 165 lbs. pressure in boilers of 216 inches diameter, we have only to reduce the diameter to carry safely a proportionately greater pressure. Thus for a 4-inch tube we should safely carry nearly 9,900 lbs. pressure. We repeat, with present day materials, it is temperature must limit our pressures. So far as a college-conducted trial has a practical value, we suppose that of the Milwaukee pumping engine, demonstrating the production of a horse-power with 11·67 lbs. of steam, has shown the best record, this being only 134 per cent. of the steam required by a perfect engine working between the same limits.

These limits were 136 lbs. and 125 lbs., or 812° and 572° Fahrenheit. A Carnot cycle, under these conditions, would utilise 29·5 per cent. of the heat passed through the engine; the Milwaukee engine utilised 19·5 per cent., though 26·3 per cent. is a supposed possibility, with expansion carried down, however, to the exhaust line. Comparing, now, the perfect engine of to-day at a pressure of 136 lbs. with the possible 500 lbs. pressure of the near future, it is shown that an efficiency of 32·7 per cent. is to be expected in place of 26·3, corresponding nearly with a ratio of 5 to 4. Whether the actual engine of the future would approach as near the perfect engine in results as it does to-day is an open question, but our professor points to a saving of 70 per cent. between the actual engine of to-day and the perfect engine of 500 lbs. pressure as an incentive to further efforts, but he recognises that unless the steam turbine, or other agency, come to the rescue, the attempt to use high pressures on our present system will provide such an encumbrance of cylinders and valves as to be prohibitory in cost and maintenance.

Having got thus far, our professor seems to feel the prophet business too much for him, and indicates a willingness to climb down from the oracular position. This he forthwith proceeds to do, and, having shorn himself of the prophet's garment, he tempers the wind by venturing to predict that, come what may in the future, engineers will prove equal to the occasion. Arrived at this comforting conclusion he meanders onwards in an aimless manner, making one good note on the steam turbine that the loss due to temperature fluctuation is eliminated, there being no fluctuation. He then takes his seat on the fence, awaiting his call in the future, to descend on such side as the practical man shall determine results to which professors may tack a mathematically adorned theory.

HIGH-SPEED ENGINE AND DYNAMO COMBINED.

We illustrate a neat arrangement of high-speed engine and dynamo combined. The engine, which is one of a series recently introduced and manufactured by Messrs. Ransomes, Sims & Jefferies, is double-acting, the construction being that known as the "open" type, and has been specially designed for driving dynamos and other high-speed machinery either coupled direct or by belt.



The general design will be understood from the illustration, but it may be mentioned that the engine can be built with the valve chest and fly-wheel reversed in position if desired.

In calculating the strengths and wearing surfaces of the various parts, a very high boiler pressure and an ample margin of safety has been allowed for; and, while such a course is not recommended, these engines may be worked

direct from the boilers of triple expansion engines without risk of breakdown or heating. All reciprocating parts are accurately balanced. The cross-head is of cast steel, and the gudgeon is so fitted that the loosening of one nut and a slight tap will release it, and admit of the examination of the brasses. The cross-head gudgeon and the crank-pin are both of very large diameter, and the width of each of these bearings is equivalent to twice the diameter; the shaft bearings are also of exceptional size. All bearings are provided with screw adjustments, and can be got at without the slightest difficulty.

The lubrication of every working part is automatic and continuous; the cylinder is provided with a self-acting cup, and the crank pin is fitted with a centrifugal oiler. This oiler, and the cups at the top ends of the rods are supplied from a central oil box conveniently placed, and provided with a sight-feed arrangement to each supply pipe. A neat wrought-iron splash guard, not shown in the illustration, is provided.

The engine illustrated has a cylinder 8½ inches diameter by 8 inches stroke, and is fitted with an automatic expansion "shaft" governor, patented and manufactured by Messrs. Ransomes. This governor acts direct upon the piston slide valve, and varies the cut-off in proportion to the load. A throttle valve governor on the Pickering principle is fitted instead of the "shaft" governor if preferred. The speed can be adjusted as desired while the engine is running with the Pickering governor, and a special patent attachment can be provided with the shaft governor to secure the same object.

The engine in the illustration is coupled to a dynamo manufactured by Messrs. Laurence, Scott & Co., the electrical output being 180 ampéres at 65 volts and 270 revolutions. The field magnets are constructed of special magnet steel cast in one piece. The armature is built up in the usual way with charcoal iron discs, each of which is driven by three keys from the shaft. The conductors of pure copper strip, well insulated with mica, are let into slots milled in the discs. An extremely strong mechanical job is thus made, while the magnetic and electrical difficulties that were at one time involved in these slotted armatures are entirely overcome by correct proportioning of the different parts. By the same careful design, and by means of Messrs. Laurence Scott & Co.'s patent pole pieces, the sparking at the commutator, and the excessive lead required for the brushes, are entirely obviated; the lead required up to half load being 0, and only 7½° for full load.

The engines are manufactured in six standard sizes, and the combined plants are erected by Messrs. Ransomes at their works, and subjected to a thorough test before being sent out.

NEW PATENTS—1894.

12,241. "Electro-magnetic traction." J. PERRY and T. TOMLINSON. Dated June 25th.

12,253. "Electric staff and tablet detector." H. POWIS and G. EVANS. Dated June 25th.

12,283. "Improved block system on electric railways and apparatus therefor." E. LANGEN. Dated June 25th.

12,290. "Improvements in gripping devices for and in connection with pencil cases, sewing machine needle bars, surgical and mathematical instruments, door handles, arc lamp carbon holders, cut flower and bouquet holders, holders for chemical test tubes, sliding rods in photographers' head-rests, ventilators, and other objects." T. JENNER. Dated June 25th.

12,304. "Improvements in and relating to electric telephone systems." H. N. FRENAY-OLYFF. Dated June 25th.

12,345. "Improvements in transformer systems of electrical distribution." P. WRIGHT. Dated June 26th. (*Complete.*)

12,349. "Improvements in or relating to heating metals electrically." W. P. THOMPSON. (Communicated by C. L. Coffin, United States.) Dated June 26th. (*Complete.*)

12,400. "Improvements in regulators for electric arc lamps or lighting apparatus." F. SUISSE and P. E. HENNEQUIN. Dated June 26th.

12,406. "Improvements relating to electric and other motors." T. E. WALTHAM. Dated June 26th.

12,411. "Electric igniting device suitable for lighting tobacco pipes and cigars." F. W. SCHINDLER. Dated June 26th.

12,476. "Improved system of switching and regulating apparatus for central stations for the generation and distribution of electrical energy." J. S. RAWORTH. Dated June 27th.

12,483. "Improvements in or connected with electric batteries." C. P. SHREWSBURY, F. L. MARSHALL, J. COOPER, and J. L. DOBELL. Dated June 27th.

12,492. "An improved construction of holder for incandescent electric lamps." W. U. HILLIAR. Dated June 27th.

12,505. "Improvements connected with arc lamps." J. J. RATHBONE and A. CHESTER. Dated June 27th.

12,510. "Improvements in apparatus for supplying electricity to electrically-propelled vehicles." E. CHABEAULT. Dated June 27th.

12,541. "Improved apparatus for intermittent measurements of alternating currents." F. H. NALDER, C. W. S. CRAWLEY, and A. SOAMES. Dated June 28th.

12,549. "Improvements in cables for telephonic and telegraphic purposes." M. IMMISCH. Dated June 28th.

12,552. "Improvements in protecting, and in fittings for connecting lead covered, or other armoured electric cables with naked or other conductors." G. H. NISBETT. Dated June 28th.

12,557. "A system of luminous electric skipping rope." G. TROUVE. [Date applied for under Patents &c. Act 1883, Sec. 103, June 18th, 1894, being date of application in France.] Dated June 28th.

12,566. "A dust-proof electrical switch." A. E. WILLIAMSON. Dated June 28th.

12,605. "Improvements in, or in connection with long distance telephones." W. A. NIKOLAJCZUK. Dated June 28th. (*Complete.*)

12,620. "Improvements in electric arc lamps." J. T. NIBLETT and M. SUTHERLAND. Dated June 29th.

12,650. "Improvements in storage battery plates." B. M. DRAKE and J. M. GORHAM. Dated June 29th.

12,707. "Improvements in or connected with electric lamp-holders, sockets, or connections." J. B. VERITY. Dated June 30th.

12,748. "Improvements in mounting electric and other lamps." W. NEWBIGGING. Dated June 30th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1893.

2,740. "Improvements connected with electric arc lamps." J. J. RATHBONE. Dated February 7th. The inventor suspends an armature from a loop, and forks the lower part to partially enclose a wheel on which a rubber, or other band, is preferably arranged as a bite or grip on a cord which supports the carbon carriers. Behind, or at some convenient part of the casing, he arranges an electro-magnet which has the power to draw the armature to it, and pull the wheel along; this wheel may be put into contact with an incline to give it a partial rotation. The wheel and armature fall to a perpendicular position when the lamp is not working, but the current has the power by the magnet to draw them, so that the wheel shall ride upon a contact piece and feed the carbons. 2 claims.

3,666. "Improvements in and relating to the distribution of electrical energy." W. LOWRIE. Dated February 18th. Relates to the distribution of electricity by the parallel converter system, whether with continuous alternating or undulatory currents. 2 claims.

4,144. "An improvement in the electrodes of electric, galvanic and other batteries." A. W. ARMSTRONG. Dated February 24th. A cap is placed over the joint between the insulated wire and the body of the electrode, so as to protect this otherwise weak part, and hold the wire firmly in position. The hollow part of the cap may be filled with any suitable plastic material, thereby securing a double protection to the wire exposed. The cap is then milled down to the insulated wire by any suitable milling tool. 1 claim.

4,685. "Improvements in recording and reproducing tapes for electrical ticker machines and other apparatus." J. E. BOTT. Dated March 3rd. Consists of a reel of paper of suitable width and thickness prepared as follows:—The paper is first impregnated with plumbago and then passed through an electrolytic bath; during its passage the paper becomes coated with a deposit of tin, or a tin alloy, of sufficient density and softness to enable it to receive the delicate recording indentations from any form of point or tracer, and as the paper, after being electrically coated in the bath, leaves the same, it is passed through rollers under pressure in order to ensure perfect width and proper thickness. 2 claims.

4,696. "Improvements in gas and other internal combustion engines." D. DAVY. Dated March 3rd. The object of this invention is to economise the consumption of gas or combustible vapour by causing the burning gases to heat and expand a relatively large volume of air preferably interposed between the combustible charge and the working piston, the explosive charge and the air being compressed to about the same degree, but contained in different chambers, so as to remain or be kept separated until, by the ignition of the former, the burning gases are caused to expand into, mix with, and highly heat, the air contained in the working cylinder, the surplus heat of the burning gases being thus converted into work by the expansion of the air. 2 claims.

5,470. "Improvements in or connected with electric signalling on railways." H. SIBERY. Dated March 14th. Claim:—In electric signalling on railways, the combination of several isolated groups, each consisting of a different number, of pairs of contact plates

arranged upon the line, each group corresponding with a given position of the semaphore signal arm, a corresponding device carried by the engine or carriage, so that in its passage it will complete the circuit between each pair of contact plates in turn, an electric bell or indicator located in the circuit on the engine or carriage, several sets of contact plates at the signal box electrically connected with the corresponding contact plates of the line, a contact-making device carried by the signal lever at the signal station or box for completing the circuit with each set of plates in turn, according to the position of the semaphore signal arm, and an electric bell or indicator arranged in each circuit at the station or signal box, substantially as shown and described, and for the purpose stated.

6,254. "Improvements in electric arc lamps." A. L. Shepard. Dated March 23rd. In the improved arc lamp the inventor provides means whereby the carbon pencils are controlled by two suitable electrical devices, both aiding one another to regulate the lamp, one governed by the main current adapted to strike the arc and also to rapidly adjust the carbons to compensate for sudden changes in the current flowing in the circuit of the lamp, and the other governed by a current shunted on the arc, designed to allow the carbons to feed slowly together when the potential on the arc has reached the desired amount. 6 claims.

7,082. "Improvements in flexible brackets for electric lighting and other purposes." F. W. Ketley. Dated April 6th. Claims:—1. The use of an elastic outer coating gripping an inner tube of flexible metallic coils, so as to give a stiffness and position retaining power to the combined tube for the purposes mentioned. 2. Adjustable flexible brackets for electric light holders or for similar purposes, entirely or partly composed of a length of the compound flexible and position retaining tubing manufactured as described.

7,407. "Improvements in electric meters." J. W. Jones. Dated April 11th. Relates to improvements in electric meters which depend for their action on the difference of rate of two clocks, which difference is caused by the current to be measured, and is proportional to the current measured. The inventor fixes to each pendulum or other reciprocating part a small magnet, the magnets being arranged in such a position relative to each other that they exert a small attractive or repulsive force on one another; the effect of this arrangement will be to keep the pendulums in such a phase that the change of attraction and repulsion is a minimum. 2 claims.

7,594. "Improvements in the electrolytical decomposition of chlorides and mixtures thereof, and in apparatus for the purpose." F. M. Lyte. Dated April 13th. Consists essentially in effecting the electrolysis of fused metallic chlorides (or mixtures thereof) within a bell chamber, which is sealed by dipping into fused metal corresponding to the base of the chloride, or resulting from the decomposition thereof, so that the pan or vessel in which the bell-like cell is contained will never be exposed to contact with the chloride or the chlorine evolved therefrom. 6 claims.

7,714. "An improvement in electric targets." A. J. H. Wyatt. Dated April 15th. An arm projecting from this bull's eye plate bears against one arm of a somewhat heavy wheel fixed on a vertical axis, capable of revolving, and urged by a suitable spring into position to keep the bull's eye against the front plate. When the bull's eye is struck by a bullet it makes a stroke backwards, causing the wheel to make a partial revolution in the one direction, after which it is brought back by the spring, the two movements, owing to the inertia of the wheel, occupying a certain time, during which an insulated contact piece on the axis of the wheel makes electrical connection of two spring blades attached respectively to the conductors to and from the distant station. 1 claim.

7,935. "Improvements in arc electric lamps." E. V. Buchet. Dated April 19th. Relates to a construction of electric lamp wherein an electro-magnet, wound with fine wire in shunt, determines the action of the mechanism for regulating the distance of the carbons. 4 claims.

8,331. "Improvements in electrical lock and block apparatus for railway points and signals." E. Tyer. Dated April 25th. Relates to electrical apparatus applied to railway point and signal levers in such a manner that a signalman at a distance could lock or unlock those levers, according as the section of the line with which he had to do was occupied or unoccupied. 2 claims.

8,812. "Electrical apparatus for raising the shutters of telephone indicators." C. D. Abel. (Communicated from abroad by Société Générale des Téléphones, of Paris.) Dated May 2nd. On the hinge of each shutter is fitted, free to revolve, a pulley from which a chain or cord passes to the core of a solenoid, which is held back by a spring. By means of a stud on the pulley under the fallen shutter, the shutter is raised when the solenoid is excited by an electric current 4 claims.

8,958. "Improved apparatus for applying electricity to the body." C. G. B. Rigola. Dated May 4th. Instead of using the core of soft iron usually employed for varying the intensity of the current, the inventor places a cylinder or sleeve around the coil, and arranges it to be moved by means of a knob moving along one side of the box containing the apparatus. He also arranges the connections so that not only the current of the secondary coil of the induction coil can be applied, but that the primary current may be used, or partly a primary and partly a secondary current. 3 claims.

9,181. "Improvements in gas and oil motor engines." C. D. Abel. (Communicated from abroad by Die Gas Motoren Fabrik Deutz, of Köln-Deutz, Germany.) Dated May 8th. According to the present invention, the chamber with diaphragm or piston and hit-and-miss device are utilised for regulating the speed of the engine in the following manner. The space in the said chamber behind the piston or diaphragm is put in communication with the interior of the cylinder, or with the air supply passage to the combustion space thereof, by means of a pipe or passage provided with a check valve which closes automatically after the air pressure in the chamber has either been reduced by the suction stroke of the piston, or has been increased by the compression stroke, so as to prevent the entrance or escape of air pressure to or from the chamber. The latter is furthermore provided with a cock or valve by which a restricted communication with the atmosphere can be established. 3 claims.

9,397. "Improved means for taking or transmitting power from electro-motors, applicable also for driving dynamos, machine tools, and other machinery." C. R. Garbard and T. W. Blumfield. Dated May 10th. The inventors place the axis of the motor at right angles to the axis of the shaft to be driven; they then construct a double disc having two parallel faces inside or face to face. Between these inside faces are two friction rollers of suitable sizes, one only need be attached in such a manner as to be driven by the motor; the other friction roller, which need not be the same size as the driving roller, being placed diametrically opposite the driving roller. They cause sufficient pressure for adhesion between the double disc by suitable means.

9,627. "Improved means for supporting porcelain or other imitation candles on electric light fittings." H. Faraday. Dated May 13th. One feature of the said invention consists in making the adapter-fitting with a hollow metal plug or spigot to fit into the candle-ring or socket, the said plug or spigot being slit in one or more places, so that it may be readily forced into the candle-ring or socket, and will then be securely retained therein in such a manner that it will hold the adapter-fitting in a vertical position, whilst it can be readily removed when desired. Another feature of the invention is the provision of springs so arranged on the adapter-fitting that they will retain the porcelain sleeve or imitation candle in its proper position, and will adapt themselves to varying sizes of such sleeves or candles.

19,146. "Improvements in or relating to telephone book-holders or the like." J. F. O'Brien. Dated October 12th. Claim:—A book-holder consisting of a metal tablet, card, or equivalent, bent over at its lower end and its sides, said tablet having space or spaces for advertisements, and being provided with slides, a backing or holder hinged to said tablet, and provided with apertures and cord, and a foot-plate, all for the purpose and substantially in the manner described and illustrated.

23,633. "An electric motor designed to drive continuously any clockwork or time-keeping mechanism." J. Parkin. Dated December 8th. Has been designed specially to make the electricity meter invented by Prof. Aron a non-winding instrument. 1 claim.

23,744. "Improved method of and appliances for lighting railway trains by electricity." R. J. Urquhart. (Communicated from abroad by P. de Ysasi Ysasmendi, of Bilbao.) Dated December 9th. Consists in using some of the steam power the locomotive always possesses in excess of its own requirements for driving a small steam engine combined with a dynamo, and conducting the current generated by them along the train and to the lamps in the compartments by means of wires provided with special connecting or coupling devices between the several carriages. 3 claims.

24,271. "Improvements in and connected with telephone apparatus." C. Bonnard and F. A. Piat. Dated December 16th. The object of the present invention is to dispense with the central station in private telephonic systems, by enabling each of the subscribers in the system to be placed in direct communication with any other without interfering with the conversation being carried on by any subscribers who may be already in communication. 4 claims.

24,274. "Improvements in apparatus for the electrolytic decomposition of metallic salts." C. Kellner. Dated December 16th. Mercury, in a state of rest, is arranged to form a thin, horizontal layer covering the porous bottom of one or more cells or reaction vessels situated between or over the anodes. 3 claims.

24,871. "Improvements in dry batteries." H. T. Johnson. Dated December 27th. Claims:—1. In a dry battery the combination of a containing cup or cylinder forming the positive electrode, a semi-solid filling within the same, and a negative electrode having an uneven surface embedded in said filling, substantially as shown and described. 2. In a dry battery the combination of a cup-shaped positive electrode, a porous diaphragm or cup within the same, a semi-solid mixture containing an excitant between the same and said positive electrode, a negative electrode surrounded by said porous diaphragm and having an uneven surface, and a semi-solid filling between the surface of the electrode and said diaphragm, substantially as shown and described. 3. Roughening, perforating, or otherwise making irregular the surface of the negative electrode of a dry battery for the purpose of increasing the adhesion between the said electrode and the depolarising material.

24,926. "Improvements in the method of arranging wires for electric bell and like circuits." W. Brierley. (Communicated by P. Weber and J. Heinrich, both of Nurnberg.) Dated December 28th. Claim:—For completing electric circuits as described, the bobbins or coils arranged above each other and connected with but one conducting wire, and all those arranged in a transversal row likewise, connected by but one return wire of one battery, and in which the indicators of each transversal row are provided with a metal strip, to which all the bobbins of the same row are connected.

25,016. "An improved rosette for electric wires." H. H. Lake. (Communicated from abroad by W. B. Rand, of America.) Dated December 29th. Has for its object to provide an improved rosette for electric wires, which shall be adapted to receive a suitable fuse or fuses. 6 claims.